Popular Science®

The What's New magazine

$1.50
MARCH
1982

Special section:
1982 IMPORTS
–with the 50+ mpg champs

The coming age of superhot ceramic engines

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Quick! What cigarette brand is the lowest in tar?

Don't say Carlton. Because it isn't. Though we couldn't blame you for thinking so. Carlton's been advertising itself as lowest for a long, long time. And in fact, it used to be.

But today? Just take a look at the chart on the right.

In it are a number of very interesting numbers, showing current tar levels of different brands.

What's the Ultra Lowest Tar™ brand?

Now Soft Pack 100s have less than half the tar of Carlton Soft Pack 100s.

Now Box 100s are the lowest cigarette available, bar none.

And no cigarette, matched length for length, is lower in tar than Now.

Quick! What cigarette brand is the lowest in tar?

There's only one answer—Now.

regular or menthol

NUMBERS DON'T LIE. NO CIGARETTE, IN ANY SIZE, IS LOWER IN TAR THAN NOW.

	80's box	85's soft pack	100's box	100's soft pack
NOW	Less than 0.01mg	1mg	Less than 0.01mg	2mg
CARLTON	Less than 0.01mg	1mg*	1mg	5mg
CAMBRIDGE	Less than 0.1mg	1mg	—	4mg
BARCLAY	1mg	1mg	—	3mg

All tar numbers are av. per cigarette by FTC method, except the one asterisked (*) which is av. per cigarette by FTC Report May '81.

NOW

The Lowest

The lowest in tar of all brands.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

BOX, BOX 100's: Less than 0.01 mg. "tar", 0.001 mg. nicotine, SOFT PACK 85's FILTER, MENTHOL: 1 mg. "tar", 0.1 mg. nicotine, SOFT PACK 100's FILTER, MENTHOL: 2 mg. "tar", 0.2 mg. nicotine, av. per cigarette by FTC method.

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Popular Science MONTHLY®

The What's New magazine

MARCH 1982
Founded in 1872/Vol. 220, No.3

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1982 imported cars—special section

We test 50-mpg cars and the De Lorean, preview low- and mid-price models. PAGE 91

The coming age of ceramic engines

Super-strong ceramics endure white heat to squeeze more energy from fuel. PAGE 64

Inflatable pedal plane

It can be remotely controlled while the pilot concentrates on pedaling. PAGE 70

Dome home from silo parts

Super-insulated steel igloos cluster to form a handsome modular home. PAGE 68

Fast furniture finishes: PS test results

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EDITORIAL OFFICES 380 Madison Avenue, New York, N.Y. 10017
Published monthly by TIMES MIRROR MAGAZINES, INC., 380 Madison Avenue, New York, N.Y. 10017

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Published monthly by
TIMES MIRROR MAGAZINES, INC.,
380 Madison Avenue, New York, N.Y. 10017
A Times Mirror Company
ISSN 0161-7370

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PS READERS TALK BACK

Address letters for this column to: Readers Talk Back, Popular Science, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

Back to the earth

Your article, "Rammed Earth" [PS, Dec. '81], reintroduced an interesting use of a common construction material: soil. You failed to point out, however, that structures of rammed earth should be used only with extreme caution because of their inherent low resistance to seismic shaking. Since the turn of the century, various parts of the U.S. (not just the West) have experienced earthquakes of sufficient severity to cause damage to man-made structures. Fortunately, the loss of life has not been large compared with such events in other parts of the world. One reason is that wood-frame buildings, the common type of non-engineered structure in this country, are less susceptible to collapse than are buildings of mud, adobe, and unreinforced masonry—materials akin to rammed earth that are commonly used in other parts of the world. This is not to say that rammed earth has no place as a building material, but that its use should be approached with caution.

Marvin R. Pyles, Corvallis, Ore.

Rammed-earth walls make the best houses for people to live in. I know, because I'm a general contractor who has built rammed-earth houses for a living for the past four years—in California, where building codes are strict and earthquake consciousness is high. Unfortunately, the labor-intensive construction method is currently inconsistent with our material-intensive society. I believe that the tremendous advantages of rammed earth will eventually be realized by builders and buyers alike, but not until quite a few prejudices and preconceived notions are put to rest. Richard Day's article is a start.

David Easton, President
Rammed Earth Works
Wilseyville, Calif.

Case of the missing computer

I found William Hawkins' roundup of small computers ["New Personal Computers," PS, Nov. '81] very helpful, but one thing puzzled me: No mention was made of the Sinclair computer, even though the same issue of the magazine contained a two-page advertisement for it. Was your silence inadvertent or are you hesitant to criticize an advertiser?

William Holt, Morehead City, N.C.

Bill Hawkins replies: "Simpler than that: Sinclair did not have a ZX-81 available for us in time for the article."

Pedal pushers

I was amazed that both Jim Dunne and Ed Jacobs gave favorable evaluations of the Pontiac J2000 ["Three Little Wagons," PS, Nov. '81], despite the fact that their own brake tests showed that the car needed 140 to 160 pounds of brake-pedal force in a panic stop from 60 mph. In order to help your readers assess the pre-crash safety of cars tested by your magazine, it should be pointed out that the majority of female drivers can't push harder than 100 pounds (for males it's 185 pounds), according to a University of Michigan study.

Rudolf Limpert, Salt Lake City, Utah

Monoxide menace

Jan Kreider's recommended technique for circulating cool basement air to the upstairs of a house could result in a hazardous situation in gas-heated homes ["Alternate-Energy Answers," Nov. '81]. He says to remove the blower door from the furnace inlet plenum. But when the blower door is removed, a gaping return-air hole is created. Suddenly there is a negative pressure area sucking in 1,000 cubic feet per minute of air within inches of the gas burners. Result: an air-starved condition for the burners and production of toxic carbon monoxide.

A safer way to circulate basement air can be accomplished for less than $10. Locate the return-air trunk-line duct (it may be hidden behind drywall). Snip a hole in it *at the opposite end of the basement from the furnace.* Cover the hole

Continued

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Sears goes nose to nose with the leading competitor.

Us.

The Sears Craftsman 20-HP Full Featured Garden Tractor gives you all this:

- Smooth-operating hydrostatic transmission
- 20-HP twin-cylinder engine
- Hydraulic lift for controlling attachments
- Optional front and rear P.T.O. (Power Take Off)
- Pinion and gear steering; 2 turns lock to lock

But the Sears Craftsman also has all these other important features:

- Gives you an average of 10% more horsepower at the drawbar than they do . . . More power where you need it.
- Sure stopping . . . because the hydro control returns to neutral as soon as you hit the brake.
- A 3-way seat that adjusts to your height, your weight and your driving angle as well.
- Three models: 18, 20 and the most powerful gas-powered garden tractor you can buy, 24-HP.
- **Only $4,499.** About $697 less than the leading competitor, based on an October 1981 market survey.*

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Available at most Sears retail stores.
Prices apply only to the continental United States.

*Based on the average negotiated price for a 19.9-HP tractor in an 8-market survey of 23 dealers. Prices vary by dealer.

Them.

The comparable model of the leading competitor's garden tractor gives you all this:

- Smooth-operating hydrostatic transmission
- 19.9-HP twin-cylinder engine
- Hydraulic lift for controlling attachments
- Standard front P.T.O. Optional rear P.T.O. (Power Take Off)
- Power steering; 2¾ turns lock to lock

I want to know more about the complete line of Sears Craftsman Full Featured Garden Tractors. Send me the facts. Mail to: FF Tractor, Sears, Roebuck and Co., Sears Tower, BSC 20-04, Chicago, IL 60684.

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For power and performance
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[*Continued*]

with a flat return-air grille. Use a grille with dampers so the basement can be shut off in winter.

John Simon
Air Management Supply, Inc.
Omaha, Neb.

Jan Kreider replies: "Either method is okay if the furnace pilot light is turned off—a caution I neglected to mention."

No kidding

Since your articles presenting new energy concepts usually impress me as being practical, I wonder if you slipped in the "Wind-Power Tower" [PS, Dec. '81] to see if anyone was paying attention. If it wasn't a teaser and the writers are serious, then perhaps the backers are out to pull Uncle Sam's leg to the tune of $5 million.

Among the many problems evident in the proposal—aside from the glaring one of building a structure 8,000 feet high—the biggest may be forcing the air to move in the opposite direction from which it would travel normally. The next major hurdle to reality is the fact that operating such a plant would create a green belt for miles around, which would lower the ambient temperature and raise the humidity, thus reducing the efficiency of the tower. Finally, the vast amount of atomized salt and minerals created will coat and corrode the inside of the tower and all the finely balanced turbine blades.

Garry Whitman, Kildare, Okla.

As an engineer, I can assure you that you cannot buy a million-horsepower worth of pumps, the world's largest desalination plant, 10 wind turbines 100 times larger than any ever built, the world's longest water tunnel, and a concrete structure four times taller than the largest structure ever built for $2 billion. Not even close. It will cost more than $9 billion just for the concrete.

Charles W. Hess, Ringwood, N.J.

Ducking the facts

I enjoyed your cover story about the Quickie plane ["180-mph Kit Canard," PS, Aug. '81]. But the title is wrong. The Q2 is not a canard but a tandem-wing airplane with negative stagger. The other design of the Quickie inventory, the VariEze [PS, Nov. '78], is a true canard (tail-first plane). The original Wright brothers' machine was also a canard. Canards are not as stable as tandem wings.

Doug Dahlke, Oshkosh, Wis.

Utilities and solar

In response to Brian Beckett of Nepean, Ont., who argued that widespread use of photovoltaic power would create problems for electric utilities ["PS Readers Talk Back," Dec. '81]: Peak demand for power does not usually occur "at supper time on a December evening" but during early afternoon in midsummer, at least in my half of North America. We have vast amounts of solar radiation when we most need power. The effect of large numbers of photovoltaic houses in this region would be to greatly increase the efficiency of utility-company power plants by closing the gap between peak and average demand. Solar cooling has even greater potential.

Mattie Ann Fincher, Baton Rouge, La.

Corrections: Contrary to a statement in "Satellite-TV Antennas" [PS, Nov. '81], the all-sports network ESPN does not offer its programming without the intermediary of a cable-television network.

We got a little carried away with our powers of 10 in "Calcu-letter" [PS, Jan.]. The nine-digit zip code will make available *only* about five discrete codes for every American, a billion in all.

An error in the "nutshell" box of the December '81 car test gave the Mazda RX-7 a lower fuel-economy rating than the Datsun 280-ZX, when in fact they both get 21 mpg in city driving. Both cars should have had a "4" rating in the box.

When our printer dropped a decimal point in the article on low-drag cars ["100+ Mpg," PS, Jan.], the Viking's extreme economy—0.72 cent per mile—appeared just the opposite. PS

LIVE LIKE A BILLIONAIRE FOR A WEEK

Enter our Cole Billionth Key Sweepstakes for fabulous prizes.

Spend a week living like a tycoon on a private luxury yacht cruising the French Riviera. That's the Grand Prize in the Cole Billionth Key Sweepstakes.

The Grand Prize winner will receive a fabulous one-week, expense-paid trip for two aboard a luxurious private yacht cruising the sun-drenched French Riviera. The trip includes airfare, all meals on board your yacht (prepared by your own private chef!) and $1000 in cash to spend at your various ports of call.

Other prizes include 2 First Prizes of an AMF Alcort Sunfish, the world's most popular sailboat... 5 Second Prizes of an RCA video cassette recorder with 6-hour recording capability and remote control... 12 Third Prizes of a Sony Walkman portable stereo cassette player... and 115 Fourth Prizes of a Texas Instruments pocket-size clock/calculator.

No purchase necessary. Entry forms and full details are available at all Cole Key Dealers through May 31, 1982. Void where prohibited by law. (RESIDENTS OF OHIO AND WISCONSIN ONLY may receive an entry form and full details by submitting a self-addressed, stamped envelope to: Cole's Live Like A Billionaire For A Week Entry Form, P.O. Box 7242, Blair, NE 68009. Limit one request per envelope. Requests must be received by May 14, 1982. Entries must be received by June 7, 1982.)

To enter, just visit the Cole Key Center at your favorite hardware, home center, or discount store. No purchase necessary.

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The Keymaker

AD 339

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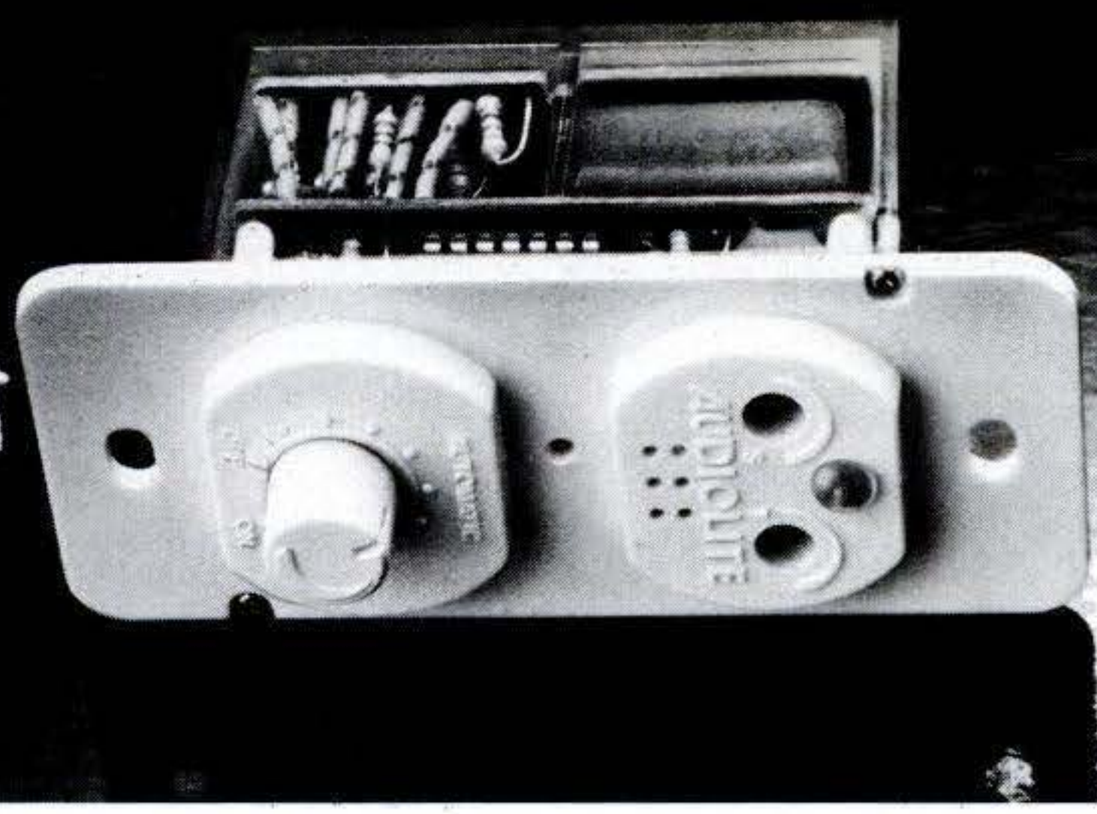


Wall plate not included.

NEWEST THIEF STOPPER. A LIGHT SWITCH WITH EARS.

Imagine entering a darkened room that lights up at the sound of your footsteps. A room that's also 'smart' enough to flick off lights when it's empty.

Imagine too, an intruder attempting to pry open your window at midnight. Suddenly, room lights are ablaze, frightening him off—and your home and family remain untouched.

And who's your fearless protector? A light switch named AudioLite.

An invention that offers security and remote convenience straight from the pages of science fiction.

A slave to your every move.

AudioLite is also a wall switch you never have to touch—because it's sound activated. It turns on lights the second someone enters a room and turns them off when they leave (works outside too—in driveways, patios, porches).

How much sound does it take? You can adjust AudioLite's sound sensor to precisely any level. At high sensitivity even the clicking of a key in a lock or the opening of a door will turn on the lights. You can also lower its sensitivity so an extremely loud verbal command or noise will be required. Or choose an infinite number of adjustments in between.

Once activated, lights remain on for the time duration you set, anywhere from 7 seconds to 7 minutes.

Don't worry about lights going off when you need them. Each time AudioLite hears a new sound, it resets and begins counting over—keeping lights on without interruption. For quiet reading, simply use the manual On/Off override. Easily adjustable timer and sensitivity controls are recessed and child proof.

Save money in more ways than you'd think.

Hall lights usually left on for hours are now on only when you need them. Likewise bathrooms, closets, garages and patios. You'll find about half the light usage in such areas is saved—lowering your utility bill accordingly.

Because AudioLite is also a full range dimmer, you use exactly the amount of light you need—as well as extend bulb life by 15 times or more.

And you needn't turn AudioLite off during the day—a daylight-sensitive photocell assures no unnecessary lights get turned on during daytime hours.

Magic that won't fade.

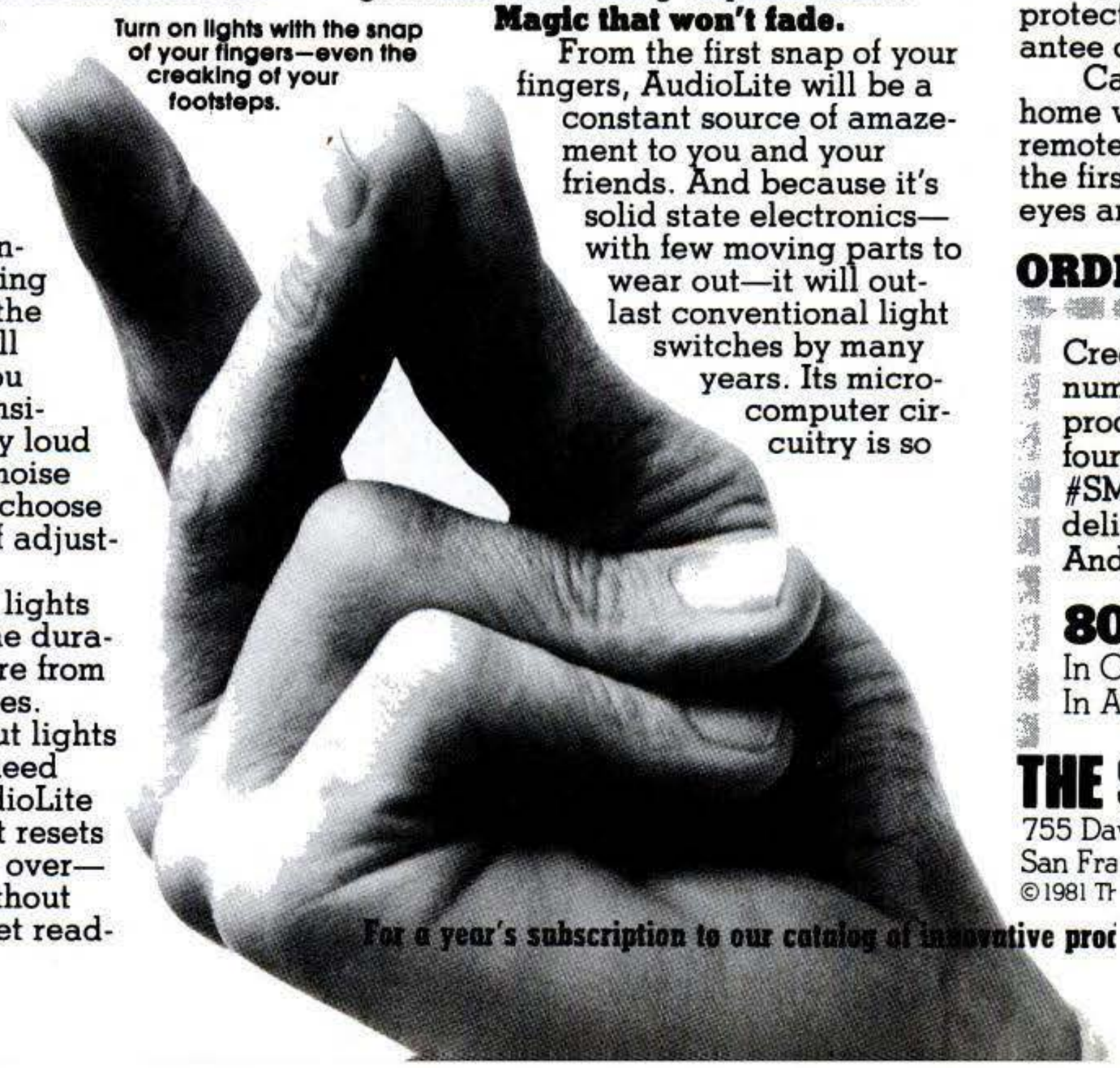
From the first snap of your fingers, AudioLite will be a constant source of amazement to you and your friends. And because it's solid state electronics—with few moving parts to wear out—it will outlast conventional light switches by many years. Its microcomputer circuitry is so reliable there's a one year total replacement warranty: should anything go wrong, the manufacturer will send you a new one, free of charge. After a year, prompt service is available by mail—but it's unlikely you'll ever need it.

AudioLite replaces your present light switch in minutes. All you need is a screwdriver. Works with any incandescent bulb up to 300 watts.

As soon as you try one, you'll want to replace all your conventional wall switches with AudioLite. That's why there's a special price if you order four at a time—$99. (For one only, the price is $34.)

However, you may order four on trial. If not perfectly satisfied after trying one, return them all within 30 days for a prompt, courteous refund. You're protected by The Sharper Image guarantee of satisfaction.

Call now toll-free, and protect your home with this newest brainchild of remote control technology. Be among the first to own a light switch with ears, eyes and brains.



Turn on lights with the snap of your fingers—even the creaking of your footsteps.

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Credit card holders use our toll-free numbers. Or send a check. Order product #SM653 for the package of four: $99 plus $4.50 delivery. Order #SM652 for one: $34 plus $2.50 delivery. Add 6% sales tax in CA. And please mention this magazine.

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ALTERNATE-ENERGY ANSWERS

By JAN F. KREIDER

Jan F. Kreider is a consulting engineer specializing in the design and economic analysis of solar-energy and energy-conservation systems. He is the author of several books on solar technology and a lecturer at the University of Colorado.

One tank or two?

Instead of the usual two-tank preheat system for solar water heating, why not use the existing water heater as the hot-water storage?

Dennis Carter, Rockville, Md.

If your primary water heater (gas, oil, or electric) is also the solar storage tank, then the water circulated to the collectors will already be heated. Thus, the only usable solar heat is that collected above the set point—usually 120 to 140 degrees F. Flat-plate collectors (the most common type in solar water heaters) are inefficient at this temperature in winter, so the economic benefit of the solar system is small.

It is possible to use a single-tank solar system if a larger-than-normal tank is used with a high-recovery-rate electric immersion heater located in the top one-third of the tank. Alternatively, a focusing collector could be used—but the additional cost of that type of collector may outweigh the savings from using one tank.

Small-hydro calculation

A small stream on our property averages three feet in width and six inches in depth. Its present flow is approximately 2.5 feet per second (1.7 mph). Based on geographic restrictions, it could be dammed to three feet high and maintain that flow. How much power could it produce?

Banks Glover, Atlanta, Ga.

To calculate the energy content of a stream, multiply mass flow by height of water drop. Mass flow equals the density of water (62.4 lbs./cu. ft.) times flow area (width times depth—1.5 sq. ft. in this case) times velocity (2.5 ft./sec.). For your stream, that's 234 lbs./sec. Water drop is three feet, so energy content is 702 ft.-lbs./sec., or about 1.3 horsepower. A fairly good water turbine could convert one-third to one-half of this energy into useful work. Therefore, you could expect about 0.4–0.6 hp, or 300–450 watts.

Pump now, generate later

We have just purchased a 300-acre fish farm in Ontario. A tremendous quantity of energy is required. Our question: Is it possible to use windmills to pump water from our pond to a holding reservoir and then generate electricity later?

L. H. McCallum, Hamilton, Ont.

Yes. This is done on a much larger scale by many public utilities that use hydro-storage for peaking power. It is an ideal way to match wind energy to your energy needs. Since you already have a reservoir, the cost of energy storage will be much less than the usual type of storage for wind systems—chemical batteries.

Rust: passive or active?

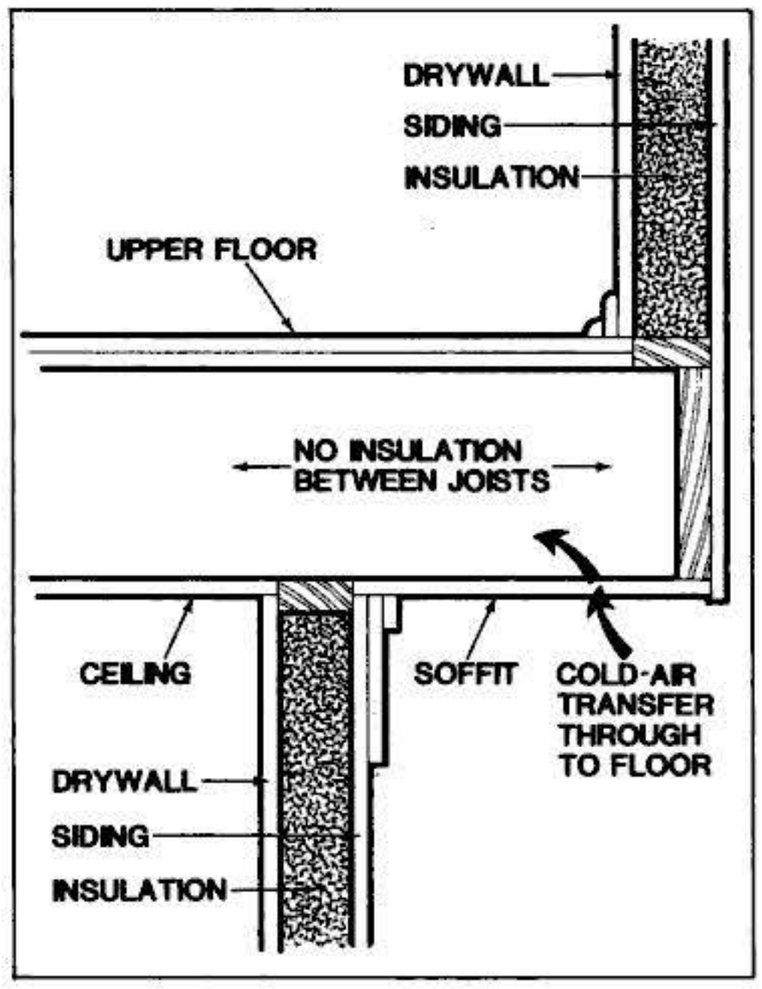
I've read articles in POPULAR SCIENCE and elsewhere suggesting the use of 55-gallon drums filled with water for heat storage in passive solar designs for dwellings. For such a fixed system, I would think that one should take care to avoid rust. Is this necessary?

Robert W. Haussler, Van Nuys, Calif.

If the tanks remain closed tightly, no rust inhibitor is needed. Initially, the oxygen in the water will react with the steel drum to form rust. However, once the initial oxygen is so consumed, no further oxidation will occur. Drums in solar buildings last for many years if exterior rust is controlled by proper priming and painting.

Cold floor

We have a garrison-type colonial home in which the second story overhangs the first (see drawing). During winter the upstairs floors are always cold. Since the first-floor ceilings are warm, why the cold floors? I find no insulation over the one-in.-by-12-in. soffit.



Einos Makie, Warren, Mich.

You have answered your own question. The uninsulated soffit plus probable air leaks cause the cold floor. Strips of foam insulation could be used both to seal and insulate the soffits if the panels can be removed. If not, you'll have to work from the outside. Or holes for blowing insulation could be cut in the vertical surface. Sealing to prevent air infiltration is also essential.

To pump or not to pump

I plan to make a preheater to run through the plenum of my wood burner to heat water. I will run the heated water first to my front room via a baseboard, then to a water preheat tank. Do I need a pump?

Don Palm, Ashtabula, Ohio

This system, properly installed, can operate without a pump. The key is to locate the tank above all other parts of the system. Cold water from the bottom of the tank will run through your heater and then through your baseboard finned tubes. From the end of the baseboard, connect a pipe to the top of your tank. To ensure good flow, it's best to slope pipe up by at least ¼ inch per foot from the hottest point in the loop. Use a minimum number of elbows and other pipe fittings.

Tracking mounts

I would like to know if a tracking parabolic trough collector should be mounted horizontally or vertically.

Neill Andersen, Colorado Springs, Colo.

A tracking parabolic trough will intersect the most solar energy if mounted in the polar mode. A polar mount requires that the axis of rotation point toward the North Pole while being tilted up from the horizontal plane at an angle equal to the local latitude. Next most effective is the horizontal mount with the axis pointed north. Least effective is east-west orientation.

Follow-up on solar colors

A number of readers requested more data on masonry wall colors and their efficiency as solar collectors ["Alternate-Energy Answers," PS, Sept. '81]. Although solar absorptance is the key parameter, emittance—a measure of the rate of radiation heat loss—is also important. This factor depends on the wall's surface finish (smooth or rough), paint materials (pigments and carriers), and color. Very few low-emittance paints exist. However, one firm—Berry Solar Products—makes a high-absorptance, low-emittance metal foil that can be attached to thermal storage walls ["Solar Sandwich," PS, July '81]. While the absorptance-emittance relationship is very complex, the following can be stated: Most flat or dull surfaces have *roughly* the same emittance; therefore, solar absorptance remains the key variable.

Got a question on an alternate energy such as solar, wind, water, or wood? Wondering about energy-conservation techniques for home heating or cooling? Every other month, alternating with "Adventures in Alternate Energy," Jan Kreider answers selected questions from readers. Send yours to "Energy Questions," POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Individual queries can't be answered by mail.

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Remembering numbers is genie work.

Busy Buttons

Turn those innocent little buttons on your telephone into Busy Buttons and release the genie from its little black box.

A fairy tale? The story you are about to read may be true or it may be false.

If the story is false, we've wasted a lot of your time. If the story is true, well...you might just make a lucky discovery. Here's why.

Your push button telephone has a bunch of buttons that make beeping sounds when you press them. The beeping sounds send signals or actually 'talk' to your phone company and its computerized switching system. That's how calls are made.

Now think of it. What if your phone was first connected to your own telephone computer. And what if in your own telephone computer you had a real genie that actually took your command and performed electronic magic on your phone lines. Far fetched? Read on.

WHAT KIND OF MAGIC

What if the system proved to be the fastest and most positive way to reach another person at another phone regardless of whether the phone is busy or whether that person is even near a phone. Enter Busy Buttons.

Busy Buttons is a miniature computer in a small black box. The box is nothing much to look at, measures only 1½" x 5" x 5¾" and in fact most people would probably hide it. The box plugs into the back of any telephone in your house or any multi-line telephone in your office. That's right, just plug it in. No installation, no wires to connect. Just plug it in.

HERE IT COMES

Now here comes the fairytale part. In that black box is indeed a real genie—a small creature so smart that it will understand every command you give it from your telephone's push buttons. No foolin'.

If you dial a number and that number is busy, you tell the genie you're upset by pressing the 'frustration' button—that's the button with a star on it. The genie will first redial that same number ten consecutive times the first minute and then once every two minutes thereafter until it reaches your party. When the call does go through, your genie will then signal you to pick up the phone. And you can still make calls and receive calls in between those times your genie is trying to reach the other party.

But what if there's no answer? After you let your phone ring for awhile, press the 'disappointment' button. The genie will then dial your number every ten minutes for up to ten hours and then signal you when somebody answers.

GENIES NEVER FORGET

"But what if the genie forgets the number it was dialing?" you might ask. The answer is quite logical. Genies never forget. In fact, you can own a genie so smart it will remember up to 176 numbers each up to 32 digits so you can not only dial long distance, you can use your genie to dial the entire 23 digit MCI or Sprint numbers in seconds. Your genie will recognize the tones, the pauses and faithfully dial your number accurately each time saving you tons of money on long distance charges.

"Too complicated," you might say. For your genie it might be but not for you. Remember, you use your own push button phone. There's no other attachment other than that dumb black box where your genie lives. And when you want to dial a number, you dial PAUL to reach Paul, MOM to reach your mom or HAIR to call your hair stylist. Remembering names is easy, remembering numbers is genie work.

THE REAL SHOCK

Ready for a real shock? You only need one genie to cover every telephone in your house or office. That's right. Unlike other auto dialers, one genie is all you need to turn every phone into this fully automatic system. But wait, there's more.

Genies talk differently. The American genie talks very rapidly in tones like most push button phones. There is even a Japanese genie that talks slowly and methodically in a pulsating sound similar to a rotary dial telephone. This means you can use Busy Buttons on push button or rotary dial telephones.

The Busy Button system is quite inexpensive. Genies you see have no minimum wage, are exempt from EEOC, EPA, OSHA, FDA and HEW regulations and don't mind putting in overtime or washing windows.

DIFFERENT VERSIONS

A 176 number Busy Buttons costs only **$200**—the 93 number version costs **$180**. If you want the Japanese Genie, you can have either model for $20 cheaper. And you can order Busy Buttons using your credit card by calling our toll-free number below. (Illinois residents add 6% sales tax.) Or send your check for the amounts listed above plus $4.00 for postage and handling to the address below.

When you receive your Busy Buttons computer just plug it in. That's right, plug it in. Then see how easy it is to program, how easy it is to redial a number either yourself or automatically. If you're not happy with the convenience of the Busy Buttons or the time and money you save from the day you install it, return it anytime within 30 days for a prompt and courteous refund including your $4.00 postage and handling charge. It won't cost you a penny and you won't insult the genie.

At the beginning of this advertisement we told you that the above story may be true or it may be false. Well it's true. There really is a genie in every Busy Buttons. And if you believe that, wait till you hear about our new computerized burglar alarm with its own built-in SWAT team. Order your Busy Buttons at no obligation, today.

JS&A® PRODUCTS THAT THINK

Dept. PS One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-7000
Call TOLL-FREE 800 228-5000
In Nebraska Call 800 323-6400

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Nobody does it better.

Winste

This is your world.
This is your Winston.
Smooth. Rich.
Taste it all.

KING: 15 mg. "tar", 1.1 mg. nicotine,
100's: 15 mg. "tar", 1.0 mg. nicotine, av. per cigarette by FTC method.

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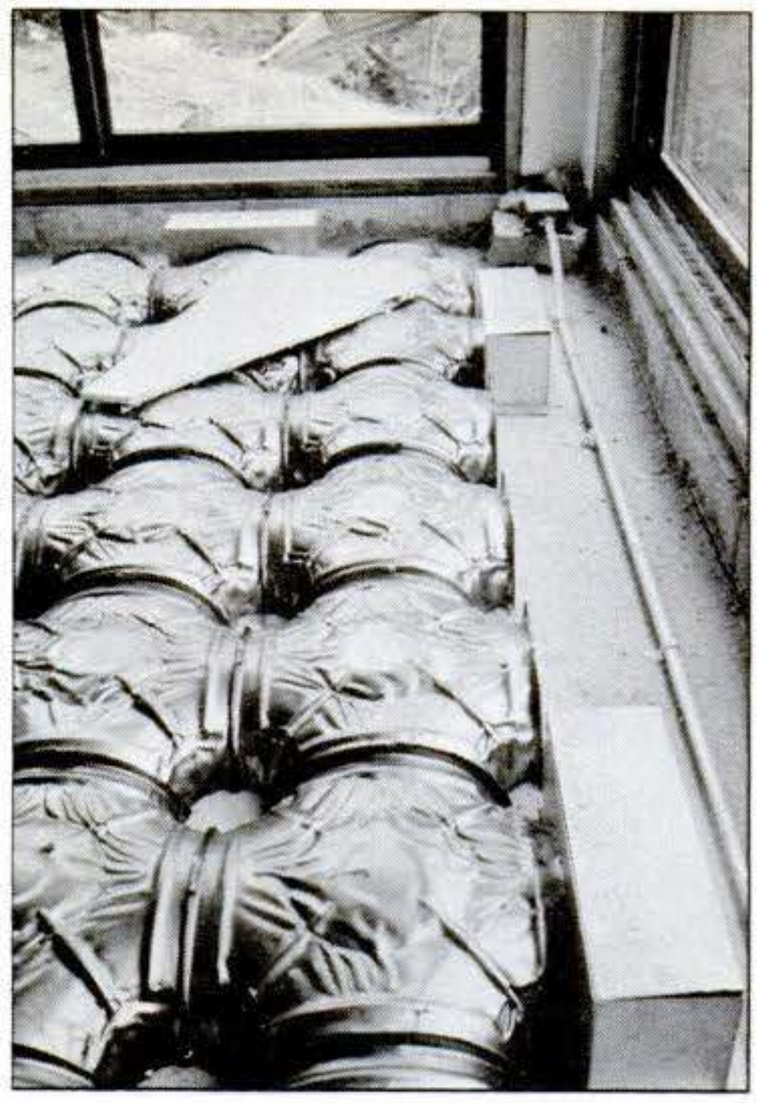
Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

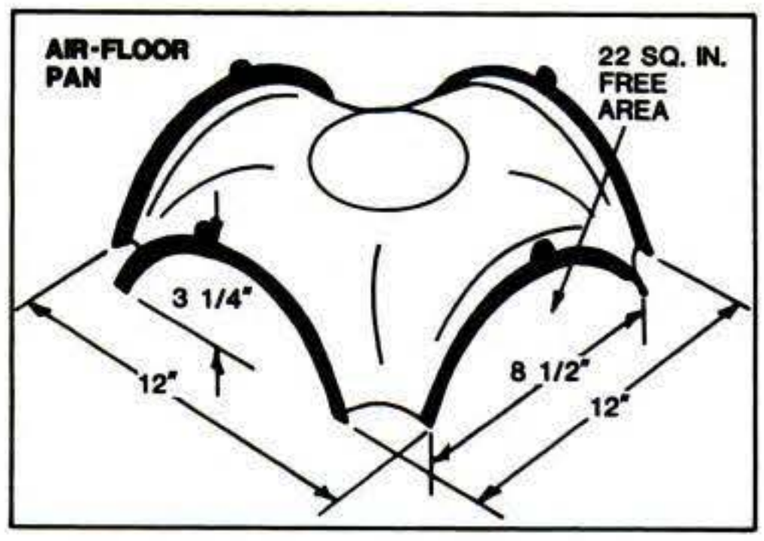
Air Floor
stores and radiates heat

Thinking about building a solar house? If so, you're probably considering the popular passive-hybrid system, and wondering how best to store excess heat. Air Floor might be just what you're looking for. It lets you store warm air in a concrete floor and provides comfortable radiant heat.

A single Air Floor pan is a 26-gauge steel stamping. It's 12 inches square and three inches high.

Here's how you use Air Floor: First, you pour a two-inch concrete base. Then you place the Air Floor pans on the base and connect them, covering the entire base. Finally, you pour the concrete floor over the Air Floor. In effect, you now have a hollow concrete floor into which warm air is fed continuously.



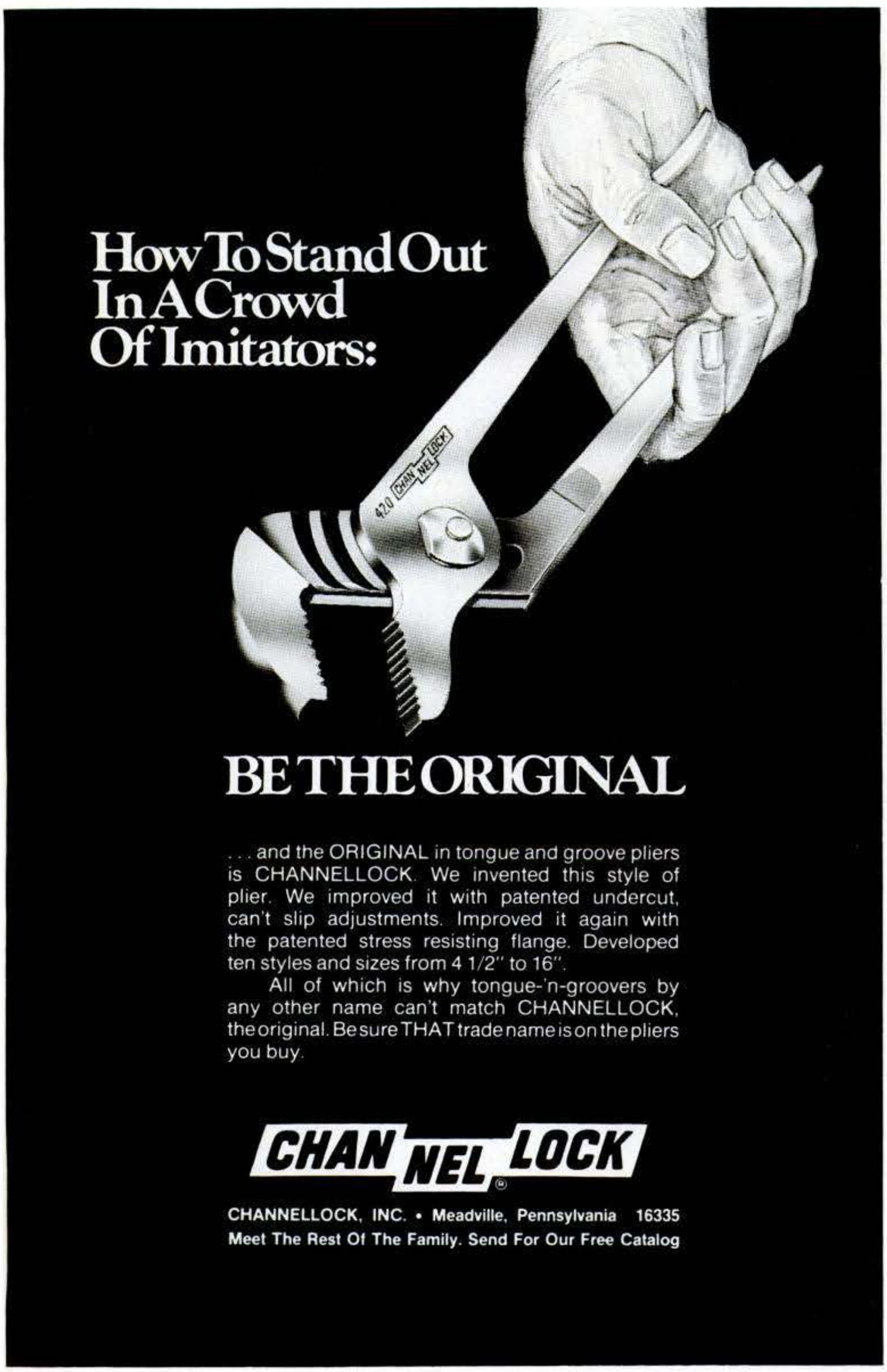


In commercial applications, warm air is forced into the Air Floor and exits through floor ventilators. About half the heat now comes from the floor outlets, and half is radiant.

In a passive-hybrid design, excess heat from a high point in the house is forced by a fan through ducting into the Air Floor. This keeps the high point of the house from overheating, while at the same time providing heat storage for sunless periods. The several inches of concrete poured over the Air Floor store the heat, radiating it out into the living area uniformly and comfortably.

Another interesting possibility for Air Floor is summer cooling. By blowing cool night air through the floor, you could use it as a storage battery to cool your house during the day. This would be ideal for hot climates that have cool nights.

Air Floor is made by Air Control Systems, 14625 Carmenita Rd., Suite 220, Norwalk, Calif. 90650. A floor pan will cost between $1 and $1.50 each, the company says, depending on where you buy.—*Jeff Milstein*



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Pocket Concert Plus

NOW WITH FM STEREO

JUST $69.50

DAK was in trouble. Orders were coming from everywhere. Our Pocket Concert Cassette Player was selling like crazy. We were guaranteed 20,000 players. We finally got 24,000. But it wasn't enough. We stopped advertising but the orders still kept coming.

We were in a jam. We offered more cash to our supplier. We researched other suppliers. But, we couldn't find a new Pocket Concert good enough to satisfy our customers, or for that matter ourselves. After all, we had advertised a product to be equal or superior to the Sony Walkman. And, we had lots of customers who expected us to deliver.

Well, not only did we finally find a great replacement, but we've even got one with FM. Now you can have the new 'Pocket Concert Plus' complete with FM stereo module for just 50 cents more than our original cassette player. It's the newest model. It's smaller, lighter and the sound's fabulous.

EXTRA HOME BONUS——We've made a special matching cable system so you can plug the Pocket Concert Plus into any line (aux) inputs in your home stereo. Now you can make copies of cassettes by playing them on the Pocket Concert Plus and recording on your main cassette deck, or just listen to your favorite cassettes through your home stereo. The sound is great. **Just $4** ($1P&H) Order no 9200.

It's uncanny. You can sit, walk, ski or mow the lawn. And think of it, you can do it all in an environment controlled totally by **YOU.**

You can be doing the most mundane task, but your mind may be soaring thousands of miles away. It's no fluke that Sony has sold hundreds of thousands of their Walkman Cassette Players.

The power of music has been used for centuries to rouse the troups and relax the kings. But, only now with the new 1½ oz. Samarium Cobalt headphones are you able to get such a kaleidoscope of sound that the outside world seems to literally disappear.

And, the effect is so total that there are even laws to stop you from wearing these remarkable players while you drive a car or ride a bike.

WHAT SOUND

And what sound you'll hear. It's easily equal to a several thousand dollar home stereo system. Yet, the new Pocket Concert Plus with both cassette and FM stereo is so small you'll hardly know that you're wearing it.

If you were on a diet yesterday, you probably lost more weight than the trifling 12½ oz. of the Pocket Concert Plus.

The Pocket Concert Plus goes where you go with a protective leatherette case that easily hangs on your belt or rides comfortably in your pocket. It also comes with an adjustable shoulder strap.

So, whether you're into long walks, sitting in airplanes or washing your car, you'll enjoy the unbelievably rich stereo sound of the Pocket Concert Plus.

ENGINEERED FOR STRESS

Most fine stereo equipment is designed to be lovingly placed on a shelf and never moved. Obviously, this isn't a practical way to listen when you're walking your dog or weight lifting.

The Pocket Concert Plus incorporates a special shock mounted drive system. And, like any of the new smaller cassette players, such as the Sony Walkman II, it is subject to some flutter and wow when it's vigorously shaken. But for walking and jogging your music will be smooth and rock stable.

The Pocket Concert Plus is specifically designed for rough treatment. Many other machines are really redesigned dictation recorders. The Pocket Concert Plus is designed to provide superb stereo music while you're on the move.

MUSIC AT YOUR COMMAND

You won't be 'roughing it' when you leave home. You can play all your cassettes since there is an equalization switch for Metal/Chrome or standard.

The sound is crisp and clean with a wide clean frequency response. The entire system is operated by 3AA batteries (not included).

There are convenient lock-in fast forward and rewind buttons, plus cue and review. If you want to listen to a song again, just press the review button without ever leaving play.

You can listen to the outside world by pushing the Mute—FM/Tape switch without taking off the feather-light stereophones. Dual volume controls, autostop and a LED operation indicator round out the convenience features.

PLUS FM STEREO

Just pop in the FM stereo module instead of a cassette and you'll be tuning in your favorite FM stereo stations.

The FM module automatically direct-couples with the cassette deck so it works off the deck's power. It feeds the FM signal directly to the amplifier, not through the head for great fidelity.

The headphone cable is used as the antenna for FM reception that is equal to the 'FM only' units on the market.

The Pocket Concert Plus utilizes a state of the art tape transport and superb electronics. It is manufactured by Unipacific and backed by a limited factory warranty.

TRY THE POCKET CONCERT PLUS RISK FREE

Take your Pocket Concert Plus on walks, to the mountains or as you commute to work. Enjoy your favorite music wherever you are and experience the incredible concert hall realism.

If for any reason you aren't 100% satisfied, simply return it in its original box within 30 days for a courteous refund.

To order your Pocket Concert Plus including the FM module, risk free with your credit card, call our toll free hotline, or send your check for just **$69.50.** Plus $2.50 postage and handling Order No. 9303. (CA res add 6% sales tax).

You'll be in control of your own environment and enjoying your favorite music with the new Pocket Concert Plus.

DAK
INDUSTRIES
INCORPORATED

Call TOLL-FREE ..... **(800) 423-2636**
In California Call ..... **(213) 984-1559**
10845 Vanowen St., North Hollywood, CA 91605

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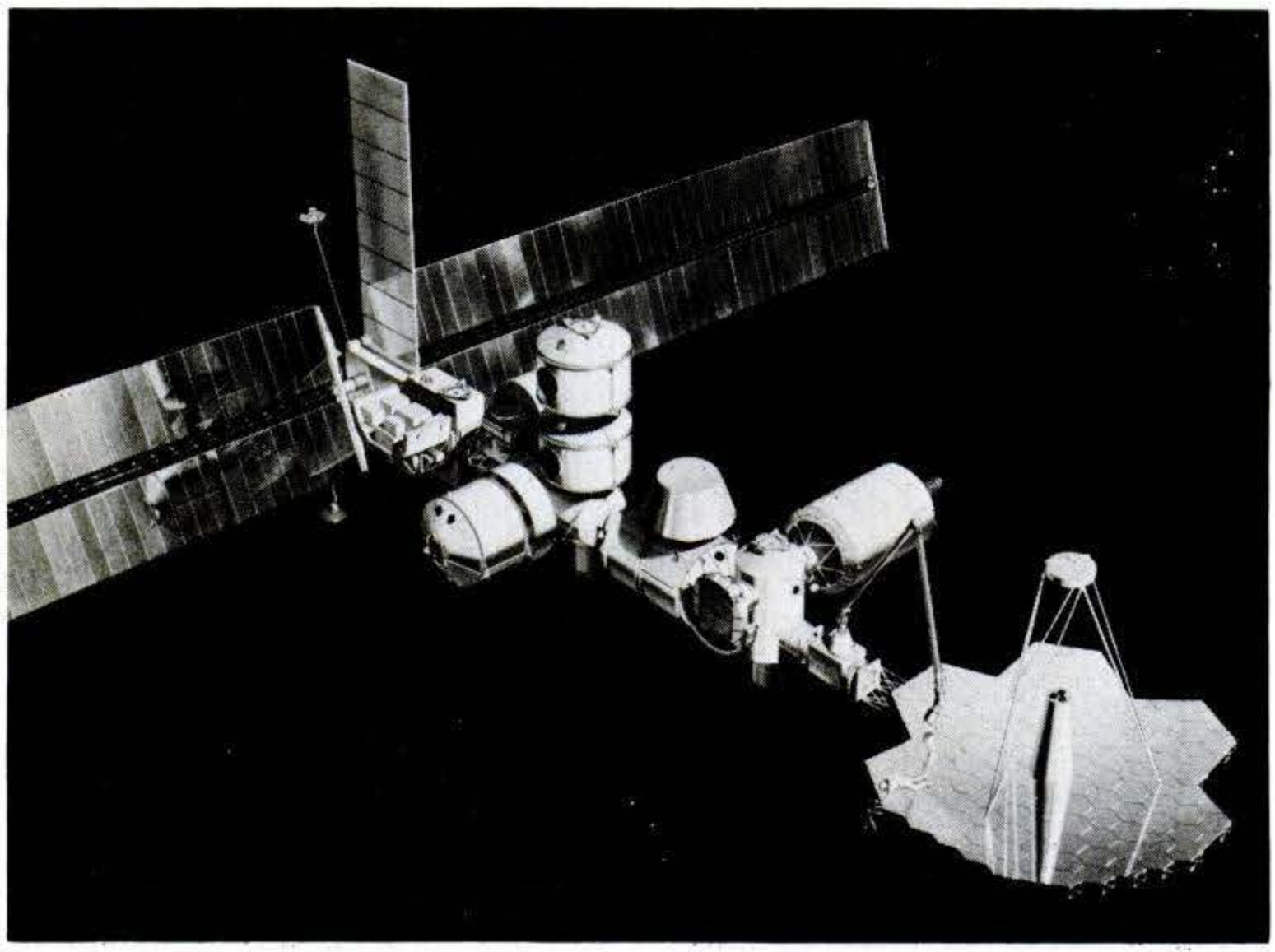
SCIENCE NEWSFRONT

By ARTHUR FISHER



Manned space base

Some artist's concepts for space stations are limited by little more than the artist's imagination. This one represents the result of a design study performed by McDonnell Douglas Astronautics Company for NASA's Marshall Space Flight Center. It shows a permanent, manned base operating in low Earth orbit that the U.S. could build in space by 1990, according to the study.

That prediction rests primarily on the fact that the station's hardware could be adapted from Skylab, the Space Shuttle, and Spacelab. Its modular construction could be expanded and contracted to meet the varying requirements of different experiments and missions. The station's three basic modules would be a 12–25-kilowatt photovoltaic power system, an air-lock adapter, and a habitat. The power system, seen here with its characteristic solar "wings," would be the first module to be placed in orbit, followed by an air-lock adapter and then a habitat-control unit based on the European Space Agency's Spacelab. An unmanned orbital transfer vehicle could eventually be linked up to move satellites or other payloads to geosynchronous orbit following inspection by the station's astronauts. The painting shows a communications satellite, at one end of the station, about to be transferred.

Space scientists anticipate that such a manned station will open a new era in the development of drugs and materials with hitherto unforeseen properties.

Lightning simulator

If you've ever witnessed a really impressive electrical storm, you may have seen a lightning stroke unlike most others—more dazzling, stouter, obviously more intense. These one-in-a-hundred strokes have peak currents of about 200,000 amperes and are capable of violent destruction.

What would happen if a nuclear weapon were hit by such a stroke? To find out, experimenters at Sandia National Laboratories have built a 30-foot-tall lightning simulator facility. (In the photo, Sandia's Bill Brigham is adjusting a test object. The machine's charge rises through the black Plexiglas dome to the attached electrode, where it arcs to hit the object.)

Actually, a lightning bolt or flash—nature's way of discharging atmospheric electricity—consists of a series of strokes. Bolts average three strokes of varying intensity, but can have a string of up to 30. The Sandia simulator generates up to four of the extremely powerful type of strokes per flash.

The lightning machine consists of four circuits, each made up of a large oil-submerged capacitor assembly charged to 1.6 megavolts; an inductor; a resistor; and a specially developed crowbar switch—the key to matching the stroke's time decay characteristics. Fiber-optic links transmit test data to computers for analysis.

"There is a chance that lightning could strike a bomb or missile," says Dr. James Bushnell, supervisor of Sandia's Electromagnetic Environments Instrumentation Division. "Even though weapons are equipped with lightning arrestors, subjecting weapons systems and components (electronics and fusing equipment, for example) to the simulator's combination of multiple strokes, continuing current, high peak current, and fast rise time should provide a clearer picture of what to expect if lightning strikes. Testing should also serve as the basis for materials behavior models."

The first series of tests at the facility will be carried out on the warhead of the Air-Launched Cruise Missile system.

Hottest gas

Data from NASA's Voyager 2 Saturn flyby have revealed the hottest gas ever observed in the solar system. The discovery was announced by Dr. S. M. Krimigis, chief scientist of the Applied Physics Laboratory Space Department at Johns Hopkins University in Baltimore, Md. Dr. Krimigis is principal investigator of both the Voyager 1 and 2 Low Energy Charged Particle experiments.

According to the latest findings from last August's Voyager 2 observations [PS, Jan.], the hot gas fills an enormous doughnut-shaped region encircling Saturn at an altitude ranging from 170,000 miles above the planet's cloud tops to as high as 450,000 miles. And the temperature of the gas ranges from 600 million to more than one billion degrees F. This is about 300 times hotter than the solar corona, or outer atmosphere, and twice as hot as the plasma cloud found during the Voyager flybys of Jupiter.

How could the spacecraft pass through such an infernal region unscathed? The density of the gas is extremely low, only about 30 particles per cubic foot. Thus, although each particle was very hot (equivalent to saying it had a very high velocity) there weren't enough of them hitting the spacecraft to heat it.

The observations were made using silicon surface-barrier detectors, developed by EG&G, Inc. (Wellesley, Mass.). These

Continued

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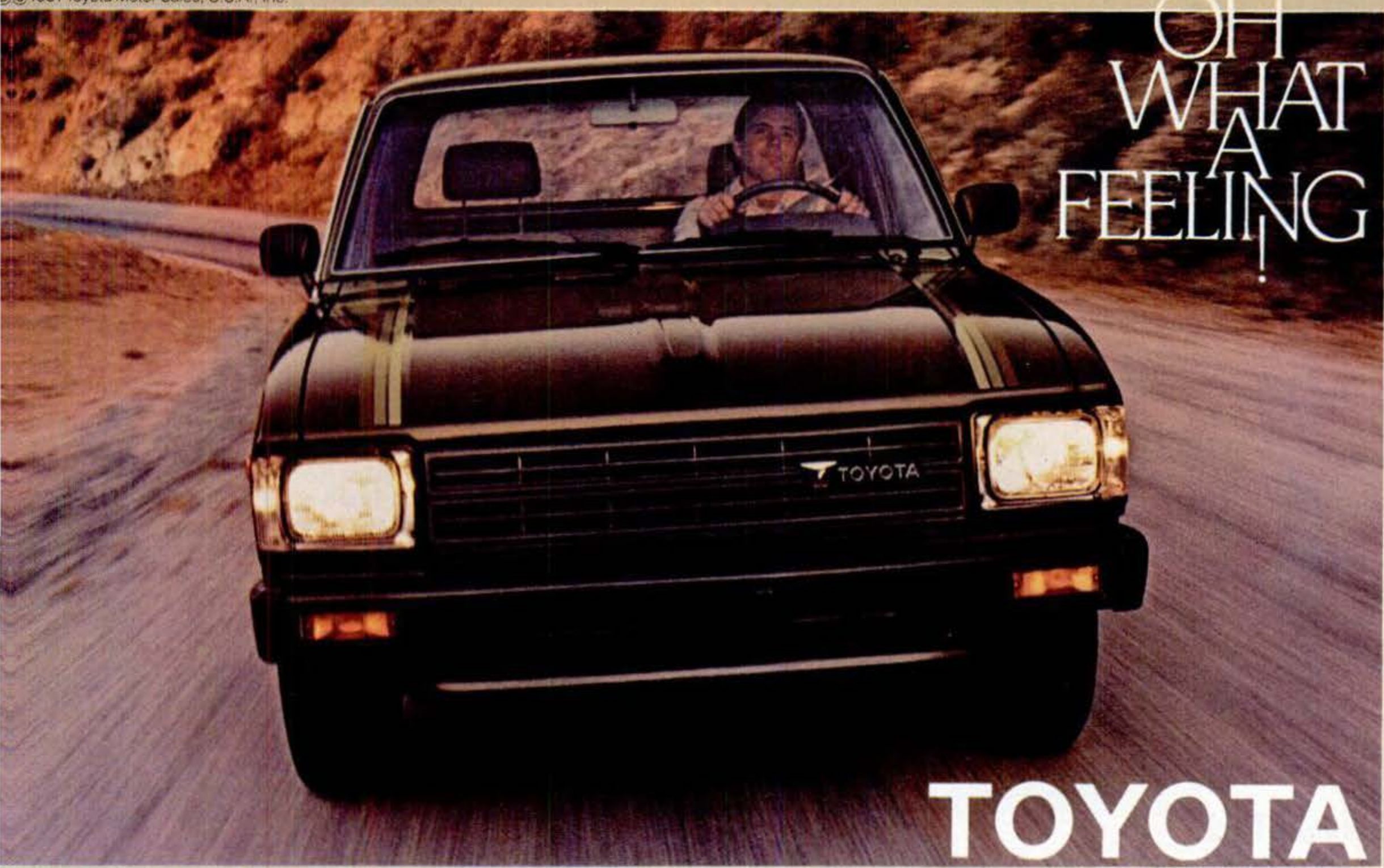


A TWO SEAT SPORTS CAR WITH A 7-FOOT TRUNK.

THE 1982 SR5 SPORT TRUCK. Two-seat sports cars are fine...if all you travel with is driving gloves and sunglasses.

But if you like to bring your toys when you go places, take this two-seat sports machine.

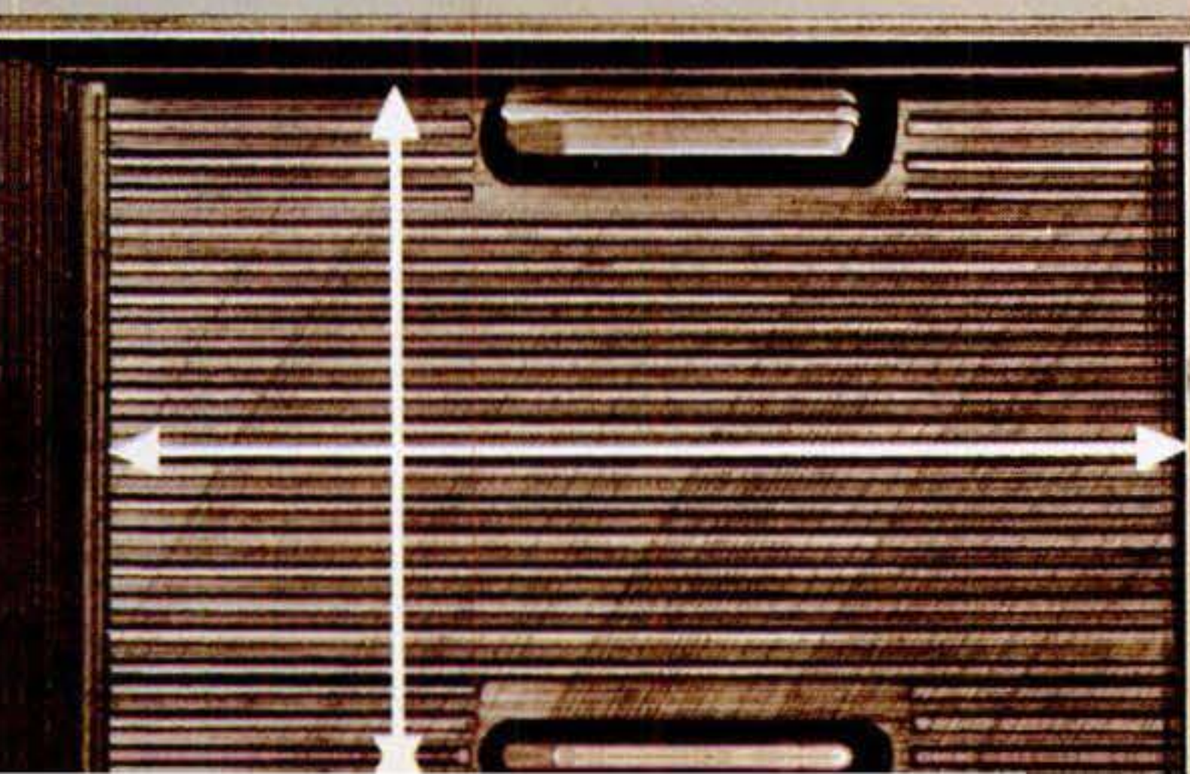
Its 7-foot trunk holds a dirt bike, a snowmobile...almost any payload up to 1100 pounds.

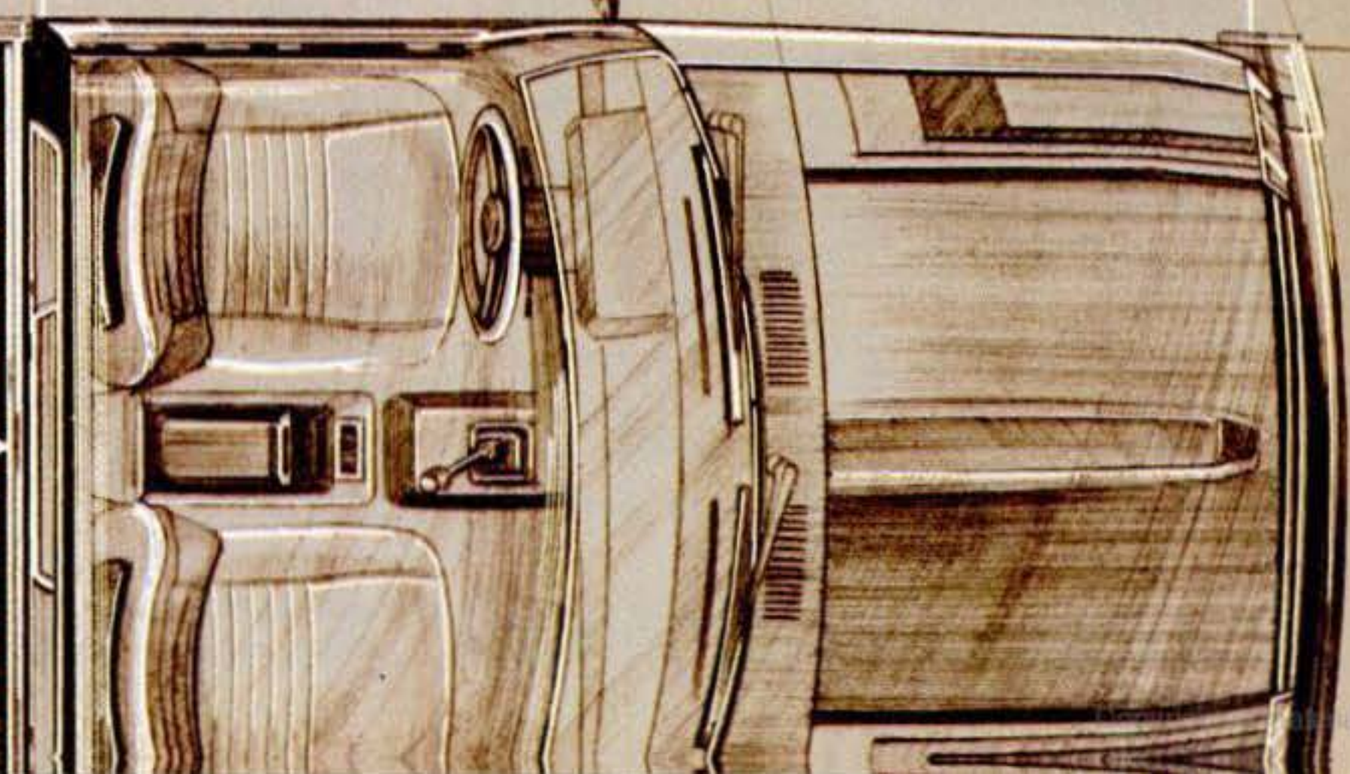
And inside, the Toyota SR5 Long Bed Sport Truck really is outfitted like a sports car. With bucket seats. Big, blacked-out gauges. Even an AM/FM/MPX stereo radio. All standard.

Start the 2.4 liter 4-cylinder overhead cam engine and the sports car feeling gets even better. You've got power-assisted disc brakes up front. A sporty 5-speed overdrive transmission. Or you can order Toyota's innovative 4-speed automatic overdrive.

And one more thing—mileage you wouldn't expect from a sports car! The Toyota SR5 is rated at 34 EPA Estimated Highway MPG, 24 EPA Estimated MPG. Remember: Compare this estimate to the EPA "Estimated MPG" of other small trucks. You may get different mileage, depending on how fast you drive, weather conditions, and trip length. Actual highway mileage will probably be less than the EPA "Highway Estimate."

The Toyota SR5 Sport Truck. It isn't hard to believe you really are in a sports car. Just don't look back!





Easy does it with

Model ET-50

ELECTRIC

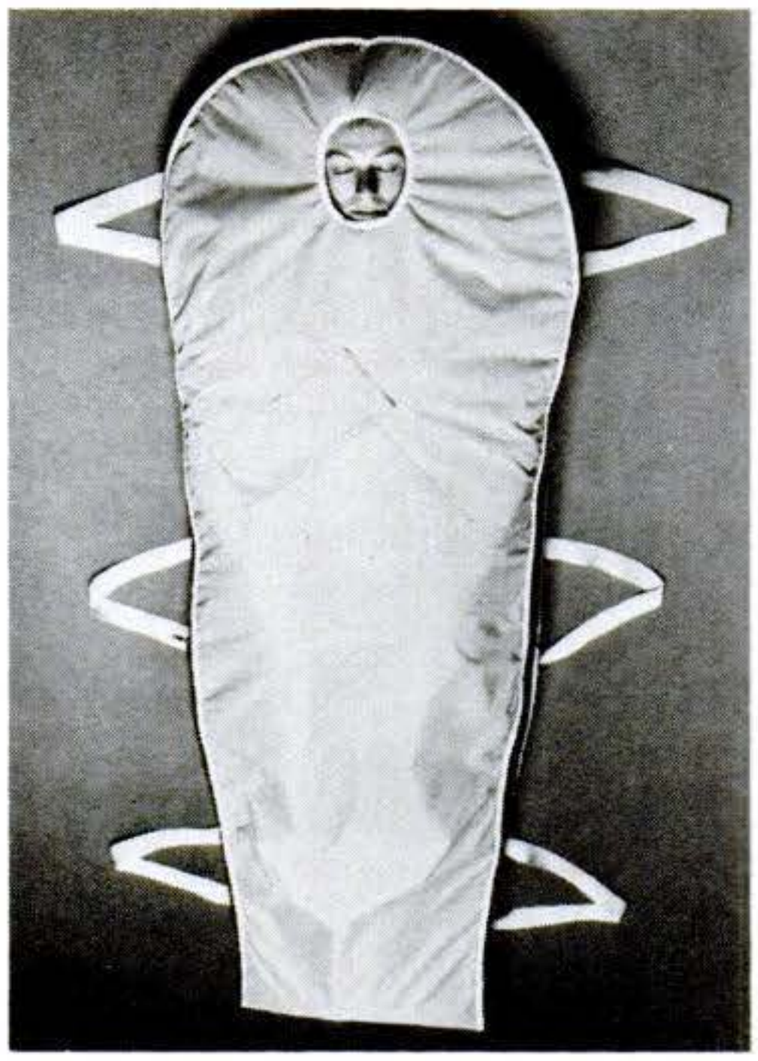
STAPLE GUN

It's TRIGGER-FAST! Just plug in . . . and SHOOT!

Its easy squeeze, trigger-fast operation makes the lightweight compact ET-50 Electro-Matic the homemaker's ideal all-around fastening tool! She'll breeze effortlessly through scores of light decorating and repair chores . . . like covering a valance, lining a closet, trimming a kitchen shelf or mending a torn screen!
Yet it packs the staple driving power to penetrate hard woods! Perfect for those man-sized jobs like installing ceiling tile, insulation and weatherstripping! Features on/off safety lock, one-piece solid steel base. Uses 6 staple sizes: 1/4", 5/16", 3/8", 1/2", 9/16" and Ceiltile.

Available at All Leading Hardware, Home Center & Discount Department Stores Everywhere.

Arrow Fastener Company, Inc.
271 Mayhill Street, Saddle Brook, N. J. 07662



Recovery capsule

The object in the photo above is not a misguided sleeping bag, but a "thermal recovery capsule" for victims of hypothermia—dangerously lowered body temperature. Made by Domtex International of England, the capsule wraps a victim in a cocoon of high-pile fabric made from polyester fiber. The fabric's capillary properties—ability to sponge up liquid—are so great, the capsule's makers claim, that a person rescued from icy water can be placed in the capsule fully clothed: His body temperature will be restored and stabilized without further artificial aid.

New catalysts for industry

Dr. Richard R. Schrock, a chemist at the Massachusetts Institute of Technology, has discovered an important new category of catalysts that could make the manufacture of a host of widely used products—including fuels, plastics, detergents, and synthetic fibers—much more efficient and economical. The catalysts would give industrial chemists the ability to manipulate two classes of hydrocarbons used as raw materials to make these products. The two are called olefins and acetylenes, and their structures have been difficult to modify because two of the carbon atoms in their molecules are linked by more than one chemical bond and therefore are hard to separate.

Dr. Schrock's catalysts are based on compounds of tungsten, which has an unusual ability to form multiple bonds with carbon. The catalysts have the effect of essentially scrambling the ends of olefin molecules to produce an entirely different olefin compound. He believes his work will lead to a whole new series of catalysts that will make possible the tailoring of numbers of different molecules with predefined functions, and that the principles on which they work will operate in other important processes, such as the polymerization of ethylene and propylene.

Komodo kuisinart

The giant Komodo Monitor, an endangered lizard of a few Indonesian islands, was once thought to be a mere scavenger, dining off the kills of predators. But the world's greatest expert on the 10-foot-long monsters (also called Komodo dragons, for obvious reasons) says they not only kill and eat 2,000-pound water buffalo, but people, too. Dr. Walter Auffenberg, curator of herpetology at the Florida State Museum at the University of Florida, reports that two tourists are the latest victims. The 200-pound lizards have inch-long serrated teeth and jaws shaped like scalpels. The Komodo, Dr. Auffenberg says, has a prodigious appetite and can consume 80 percent of its body weight at one sitting. Moreover, it is the only predator that slices its prey into neat pieces with its teeth before eating them. Just thought you'd like to know.

Swedish car lifetimes

The annual report of the Swedish Motor Vehicle Inspection Company shows that the median life of cars in Sweden has increased from just less than 10 years in 1965 to 15½ years in 1980. (The median age is the age surpassed by half the cars in the population and not yet attained by the other half.) Volvos held the lead with a median age of 19.3 years, followed by Mercedes-Benz with 16.6 years, VW with 15.4 years, BMW and Opel with 14.4 years each, and Saab with 14.2 years.

Pregnancy and alcohol

More fuel has been added to the controversy over drinking by pregnant women. The fetal alcohol syndrome is a constellation of serious physical and mental defects that can appear in the children of alcoholic mothers. Recently some experts have advised pregnant women, or those who were trying to conceive, to avoid alcohol altogether because of the risk that even a couple of drinks might have harmful consequences to the developing embryo. Other experts have declared such Draconian measures overreaction. Now two researchers at the University of North Carolina at Chapel Hill say they have new evidence, from studies with mice, that only one or two episodes of heavy drinking as early as the third week after conception can damage the unborn child. Their recommendation: total avoidance of alcohol if there is any chance a woman could be pregnant. PS

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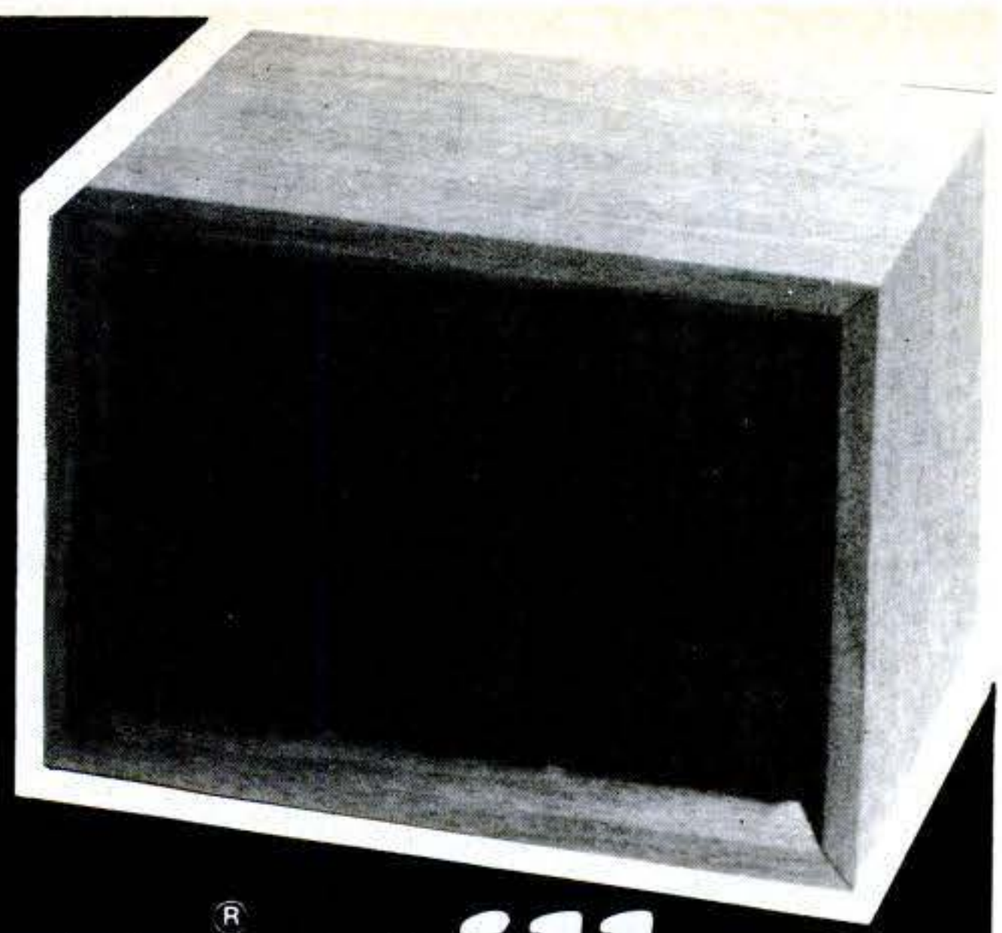
Glass won't discourage a burglar



...but guardex® will

Guardex Alarms stop burglars before they enter your home

NO INSTALLATION

Just plug the Guardex 8000 alarm system in, make two simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss... your roof, walls and floors.

A BURGLAR'S BEST WAY IN IS THE WINDOW

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

PROTECT EVERY WINDOW AND DOOR

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

Dealer Inquiries Invited

The Guardex 8000 Alarm System is walnut grain and disguised to look like a small stereo speaker (6¾" × 9¾" × 8") and weighs less than 6½ pounds. The rear view is pictured left.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

WARRANTY

One year, 100% parts and labor when returned to factory postpaid. A five year extended warranty is available for a charge of $25.00.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from main alarm, they are available with 50 feet of wire for $29.95. (Connecting terminals are provided on the back of the alarm).

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This is your opportunity to purchase an alarm system directly from the factory for only **$239.95**. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days of receipt for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of **$239.95** plus $4.95 postage, handling and insurance. If you want the optional outside siren, add $29.95. Optional outdoor 7" × 10" metal warning sign (stake not included) add $9.95. (California residents add 6% sales tax.) If you require more information, call during California business hours Monday through Friday.

Inside California call collect (213) 889-1414.
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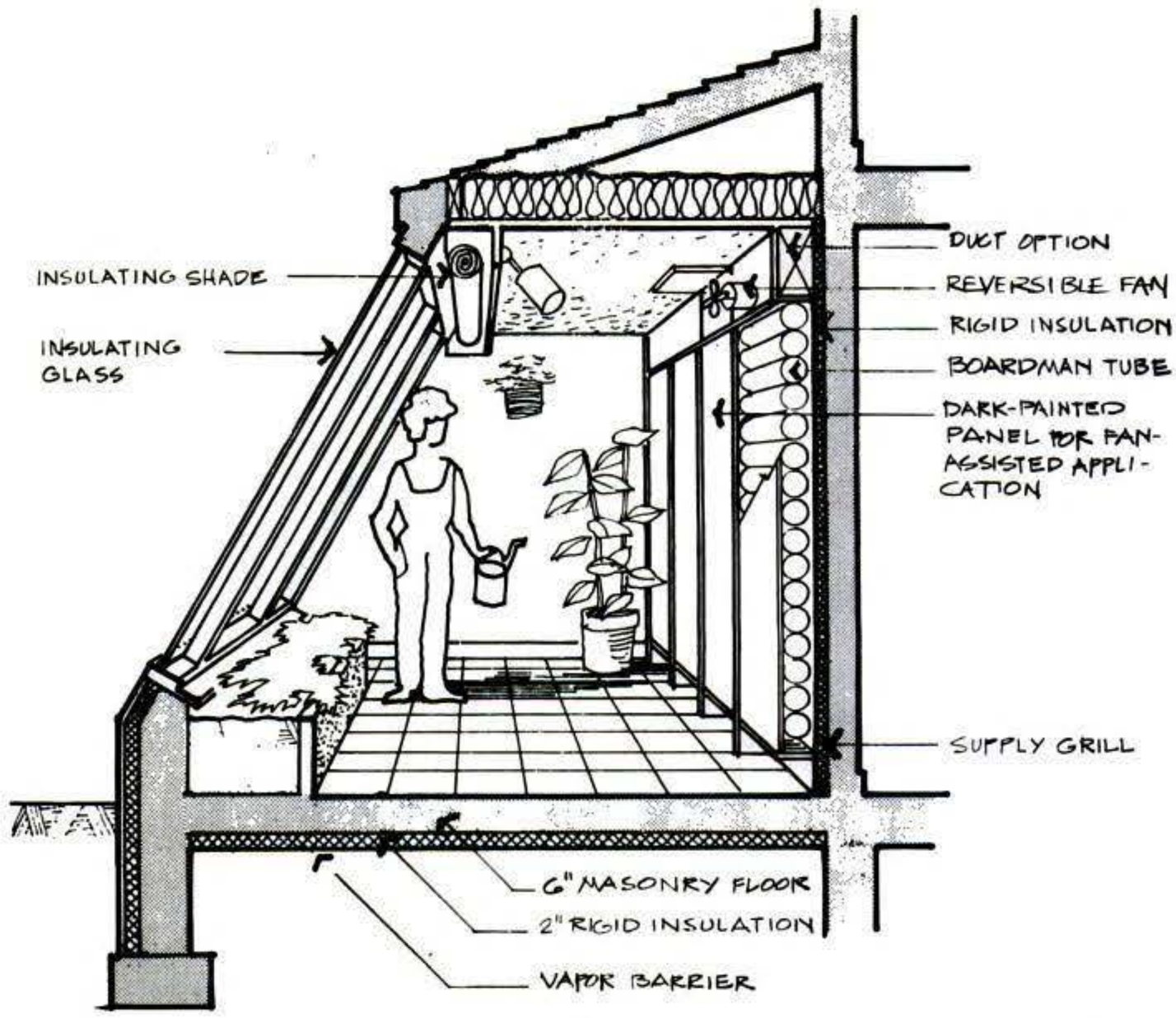
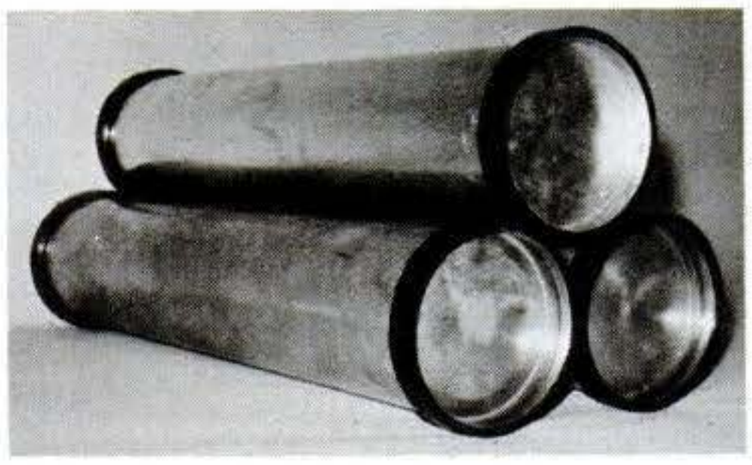
Heat-storage tube
for passive-solar design





Heat-storage wall uses a bank of Boardman plated-steel PCM tubes. The tubes (left) are 4⅝ inches in diameter and 24 inches long, and weigh 23 pounds.

Planning to use a phase-change material in a solar heat-storage application?

PCM's are chemicals that store large amounts of heat by changing from a solid to a liquid. Two problems have plagued PCM's: reduced effectiveness from chemical breakdown, and supercooling—stored heat isn't fully released at the melting-point temperature.

A new type of PCM tube from Boardman Energy Systems (Box 4299, Wilmington, Del. 19807) solves these problems, says the manufacturer, and provides several melting points for various designs. The Boardman tube prevents breakdown and supercooling problems by fixing the PCM (sodium sulfate decahydrate, or Glauber's salt) in a rigid matrix of cement that holds it in a linked cellular structure.

"Testing through over 2,000 cycles has shown no loss of efficiency," says inventor Brian Boardman. Previous designs lose efficiency, according to Boardman, when the melted salts drop to the bottom of the container. Repeated cycling gradually reduces the amount of water molecules available for combination with the salt.

A Boardman tube with an 89-degree-F melting/freezing temperature stores 2,100 Btu of latent heat per tube, says the inventor. A 67-degree tube—suitable for the lower temperatures of passive and passive-hybrid designs—stores 1,900 Btu. A 45-degree tube is suitable for air conditioning.

The firm says that about 40 tubes, requiring only two by three by five feet of space, are suitable for a well-insulated house with an active or passive-hybrid design.—*Jeffrey Milstein*

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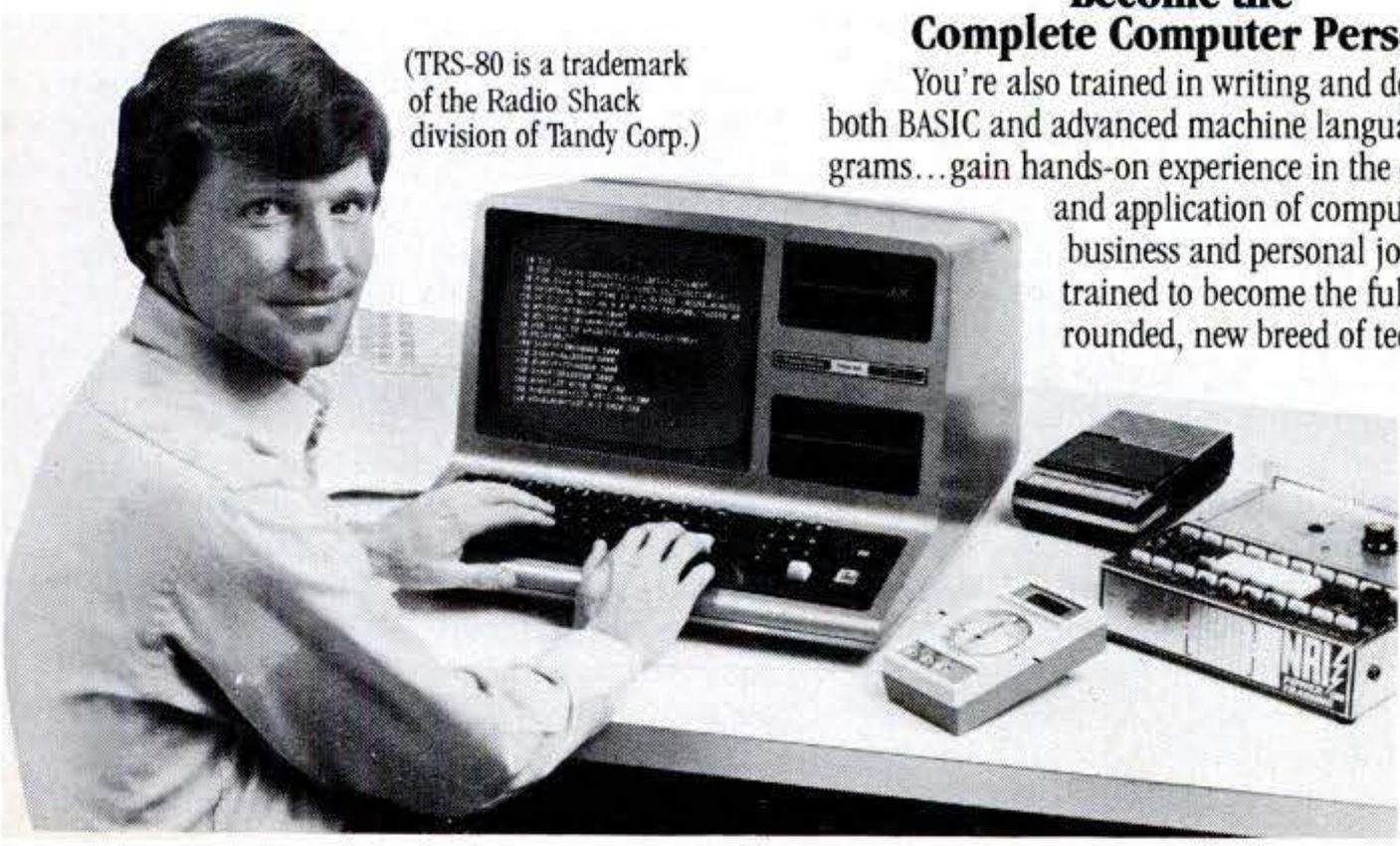

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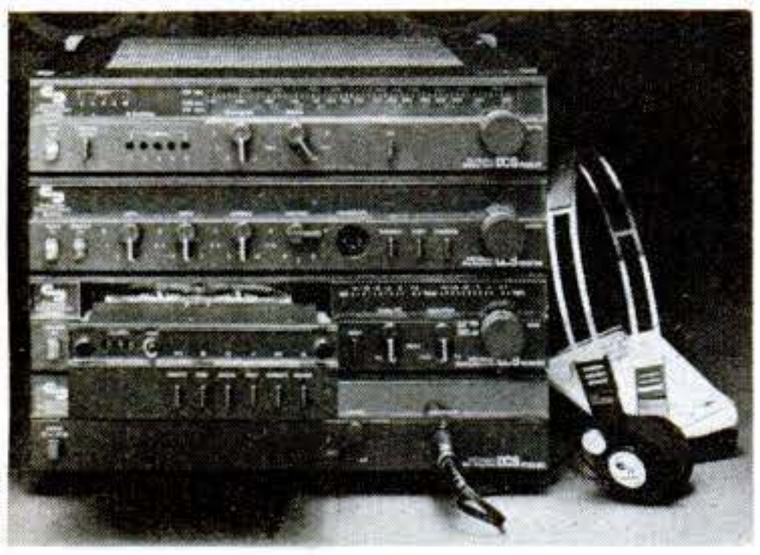
LOOK AND LISTEN

By JOHN FREE



Video for computers

Video screens pulsed with color and images. At dozens of booths, people clustered around TV sets, pushing buttons and swiveling joy sticks on control units. They were interacting with and changing the TV pictures.

An Asteroids and Space Wars arcade? No. It's what I saw when I stepped into a big auditorium in New York's Madison Square Garden recently. And the entranced videophiles weren't zapping alien spacecraft. They and I were surveying a new crop of interactive videodiscs. Instead of "The Godfather" or "The Sound of Music," these LaserVision discs had such memorable programs as how to reduce nearsightedness with surgery, or viewer-controlled tours through the Corning Museum of Glass, a West Coast harbor, or a power plant.

These optical videodisc programs are created for computerized interaction. The programmable computer is either built into an industrial disc player, such as the Sony LDP-1000 prominent at this Video Expo showcase, or the player's microprocessor is aided by an external computer. Wicat, Inc. (Orem, Utah), for example, was demonstrating its new minicomputer and a medical disc on the gastrointestinal tract (top photo).

Surrogate-travel discs pulled the biggest crowds. These feature pre-filmed tours of locations. You move through scenes—turning at corners, stopping, shifting into fast forward—with computer controls [PS, Aug. '81]. But schools and many companies are also discovering the awesome information-storage potential of videodiscs. Other booths had training and maintenance discs, sales discs for GM and Ford, an interactive encyclopedia, and a disc with 100,000 of the 700,000 U.S. patents issued over the past 10 years.

All the disc players used were the laser-scanned, non-contact type, capable of freezing TV images. Meanwhile, in Europe, RCA unveiled an advanced version of its player, a home machine designed for grooved, stylus-read discs. The prototype is capable of accessing program sections by tapping in minutes and seconds on a key pad. Variations of its new machine could also display individual TV frames, say RCA officials. The advanced players are not for sale yet.

New-look hi-fi

Ready for a new look in hi-fi components? Glance at that tuner, preamp, cassette deck, and amp stacked above (left). You're right. There's nothing new in matched, stackable components. It's what you don't see when you look behind the Schneider DCS lines from Germany that's different.

DCS stands for direct-contact system. You don't need a rat's nest of connecting cables with these modular components. Instead, the hi-fi units have recessed connectors on the sides and bottom so they can be set up above or alongside each other. Schneider North America Ltd. (Plainsboro, N.J.) is marketing the four-piece DCS-8025 system for about $1,150. How's the audio fidelity? Your ears will have to judge.

Nakamichi, which has engineered cassette decks and other hi-fi gear into state-of-the-art technology, has now taken on the turntable. The result is the TX-1000 (right photo), a computerized machine with a unique feature.

Like some audiophile machines, the TX-1000 lets you select your own tone arm. In fact, it has mounting holes for two separate tone arms. But it also has two platters: A small, so-called "center search" platter is mounted on the main-turntable platter.

Push a special button and a sensor arm emerges from the housing on the left. It traces a disc's lead-out (end) groove and sends a signal to a microcomputer. If the disc has a mislocated or oversized center hole, the computer sends a correction signal to gears, pulleys, and belts to relocate the center platter. The main tone arm(s) can then play the disc without moving back and forth, generating wow. Correcting sloppy manufacturing is costly, however. Price of the TX-1000: $7,000.

Cassette standards and CCD's

Digital audio-disc players from up to 20 firms may begin vying on the world market late this year. These compact (under five inch diameter) discs store information in a pulse-code-modulation (PCM) digital format, playing it back with a solid-state laser [PS, Nov. '81].

But the Japanese have been brewing another PCM hi-fi format: compact cassettes and machines to record and play back audio. At an audio show in Japan last year about a half-dozen major audio firms showed prototype PCM cassette machines. But, as usual, the manufacturers haven't been able to agree on a standard, so a cassette recorded on one tape machine won't work on another.

The Japanese are trying to establish tape standards for a new video recorder, too. These are the combination TV-camera/tape machines that use quarter-inch-wide tape—half that of standard VHS and Beta formats. Some firms want 20-minute microcassette packages, while others want two-hour tapes a little larger than compact audio cassettes.

A key component in the miniaturization of the TV camera for this combination is a solid-state chip [PS, Jan.] that can replace a vidicon tube. Firms have been promising consumer-model tubeless color cameras for years. Now Hitachi has introduced a $1,995 camera. Its biggest advantage might be its lifetime—100,000 hours, about 20 times that of vidicon tubes.

Another application of these tiny sensor chips, or charge-coupled devices (CCD's), is the filmless still-picture camera, the Mavica, recently announced by Sony [PS, Dec. '81]. Sharp says that it is also developing a CCD-based TV camera. One attachment would convert the Sharp unit into a single-piece VCR-camera, while another adapter would use conventional film.

Continued

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It's designed to go lots of places. Because this is one wagon that's at home at the opera as well as the supermarket.

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Look and listen

[*Continued*]

And while video electronics firms are starting to nudge into photography's turf with magnetic snapshot cameras, Nikon and Minolta are moving the other way. Both have announced plans to market compact color-TV cameras and VCR's.

CBS Cable's stereo

I almost had a source for stereophonic TV piped into my home. But not quite. CBS Cable is sending its new cultural-program service to cable systems with stereo sound on a 5.8-MHz subcarrier. Local cable companies can offer the Dolby-encoded sound for pickup on standard stereo FM receivers, with, of course, monaural sound to TV sets. New York City's Manhattan Cable—for the moment at least—isn't one of the firms providing this stereo option.

Interest in stereo TV audio is picking up—slowly. One firm, Akai, has marketed a stereo VCR for some time. This year several other companies are expected to offer two-channel TV audio in their VCR's.

Meanwhile, as proposals for U.S. stereo-TV standards inch through committees and the federal bureaucracy, West Germany has established its own stereo standard. Technically, the German system differs from the one that's been operating in Japan for several years.

Quick looks

- Videodisc players from Pioneer and RCA will have the CX noise-reduction system developed by CBS Technology Center built into them. RCA will use CX for its stereo videodiscs, slated for introduction this year. For audio LP discs, CX encoding-decoding cuts background surface noise while enabling playback on hi-fi systems not equipped with CX.
- A San Francisco appellate-court ruling last fall that makes it illegal to videotape programs off the air, even for home use, has produced several legislation proposals in Congress to exempt copyright rules for video. Such an exemption already exists for taping audio at home. Sony Corp., sued by MCA Inc. and Walt Disney Productions, may seek a reversal of the decision in higher courts. Other possible outcomes: a tax on blank tapes and VCR's for royalty payments, or even sale of VCR's without tuners (for prerecorded-tape playback only).

Cassette-rental boom

In February, MGM/CBS Home Video slated another rental program for video cassettes. Called First Run Home Video Theater, it's an addition to plans being offered to dealers by Warner, 20th Century-Fox, Walt Disney, and Paramount. MGM's plan calls for a four-month period during which new films can be rented. After that, they go on sale. February's offering was "Tarzan the Ape Man," starring Bo Derek, and the release for March is "S.O.B." The other studios have rental plans for dealers with similar sale restrictions.

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Picture this . . . you're in the living room and the phone rings. The call is for you but it's impossible to talk because the kids are playing and the T.V. is blasting. What do you do? You lay down the phone and rush to the bedroom for privacy. If only you didn't have to depend on someone else to hang up the other extension.

Wouldn't it be great if you could place the call on hold and not have to worry about hanging up the extension?

This problem never happens at the office. Why? Because you have expensive telephone equipment that permits you to put your call on hold. And you can't have that convenience at home because the cost is prohibitive. But wait, there's a new breakthrough product. **WE HAVE IT!**

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You only need ONE Universal Hold™ system to provide hold service for all the telephone extensions throughout the house.

The GTI Universal Hold™ system **will not interfere with your phone service in any way**. Absolutely not. In fact, it is compatible with all custom calling services (call waiting, three way calling, etc.).

"BUT I ONLY HAVE ONE PHONE!"

That's okay because the Universal Hold™ still provides a hold function. So, even if you only have one phone but have multiple phone jacks; after placing the call on hold, the phone can then be unplugged from one jack, and plugged back in at another location for you to resume your call.

NOTE: The Universal Hold™ is equipped with a six minute safety reset. In the event you place a call on hold and forget to resume your conversation, the Universal Hold™ will automatically disengage after six minutes to clear your line for incoming calls.

GTI Corporation, the manufacturer, has already received UL and FCC approval.

GTI is not General Telephone and Electronics Company (GTE) nor is it AT&T. GTI started out in the electronics business 25 years ago and has grown up with the electronics industry. We are an independent publicly held corporation listed on the American Stock Exchange. During that period of time, we have manufactured over 100 billion parts for such industry leaders as IBM, Hewlett-Packard, and Motorola. All of that experience has gone into our new call holding system. As a result, it's as reliable as your phone.

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ORDER NOW

To order your Universal Hold™ send your check or money order for $49.95, plus $3.50 postage and handling, to GTI Corporation Dept. PS381, 10060 Willow Creek Road, San Diego, California 92131-1699 (sorry, no COD's). California residents must add 6% sales tax.

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CALCU-LETTER

By DARRELL HUFF News of pocket calculators—and how to have fun with them

Wrist calculator

A great luxury when the first model appeared in jewelry stores (gold case, $500!), the wristwatch-calculator is now quite affordable. The one I have is highly wearable, too—hardly bulkier than my old Swiss-movement watch and half the weight. Result: It's always there. Recently, for example, when preparing for a trip abroad, I read at the library that the French franc was quoted at 5.81 to the dollar. Consulting my watch, I was instantly able to put that into a form I could understand—that one franc equals 17.2 cents. I expect that the watch will prove especially handy for metric and money conversions and for mileage calculations during my travels.

Texas Instruments offers a choice of gold, white (photo), and black cases; all have alarm, day-of-week display, and optional hour chime. The calculator has an eight-digit LCD display, percent, floating decimal, negative sign, overflow indicator, and incandescent backlight for improved legibility.

Armitron makes a similar-looking but less potent model (just the time and basic arithmetic), and Casio has models giving a choice between finger-tip keys, like those of the TI pictured, or tiny indented ones requiring a stylus or ballpoint.

I find that one of the most important considerations in buying is the feel of the keys. It's amazing, though, how easy it

becomes to push the tiny things even with blunt finger tips. The lowest price I've seen so far is for the basic Armitron—just under $25 at a discount house. It's an economic and technical miracle, any way you look at it.

Prime fix

Brilliant new ciphering methods for military and business secrets, based on prime factors, were discussed in the November '80 "Calcu-Letter." I mentioned then a 13-step program I used to find the prime factors of a six-digit number. It worked fine—but when applied to a much larger number it sprinkled the correct results with some near misses. Why, I asked, would my calculator do that to me?

Marta Pohar, of Marmora, Ont., knows why. And she has a fix to offer. My faulty program must have been using a test of the decimal part of the quotient to see if it was zero, she says; and she's right. All went well until the difference from zero came only in the digits beyond the working capacity of the calculator. Then it was fooled, and so was I.

Here's the better way. Divide the original number by the presumed factor you are testing. Then re-enter the result, thereby dropping any hidden decimal, and multiply by the factor. It's a true factor only if this result is the same number you started with.

Try it. Dividing 86,419,747 by 7 on an eight-digit calculator would seem to tell you that 7 and 12,345,678 are among its factors, although you can see they aren't. The test eliminates them. With a 10-digit calc, divide 9,999,999,999 by 7,143.

Clever packing

In this column last May I mentioned that the book *Solar Energy Calculations* (Solarcon, 607 Church, Ann Arbor, Mich. 48104; $25) suggested a clever method to pack unrelated pieces of data into a single calculator memory. Several readers wrote to ask how it's done. Here's an example:

Suppose you are doing a solar-design problem and must store insolation, temperature, and degree-hour data for each of many months. For one January, solar radiation rounds to 573,800 kilojoules per square meter, average ambient temperature is −2.8 degrees C, and degree-hours total 16,100. These figures can all be compressed into a single line, says author Roderich W. Graeff, by simply entering −5,738,028.161.

That's easy, but how do you get the original numbers back when you need them? To unpack the first value, divide by 1,000, specify integer, multiply by 100, specify absolute value. Unscramble the second figure by taking the integer part of the stored value, dividing by 1,000, taking the fractional part, and multiplying by 100. Unpack the third number by summoning the absolute value of 100,000 times the fractional part—and you've added one more element to your mastery of that incredible tool, the hand calculator. PS

PS calculator columnist Darrell Huff (P.O. Box AS, Carmel, Calif. 93921) is the author of *How to Lie with Statistics, How to Take a Chance,* and other works. He welcomes comments, solutions, and suggestions.

CALCU-PUZZLES

What size circle?

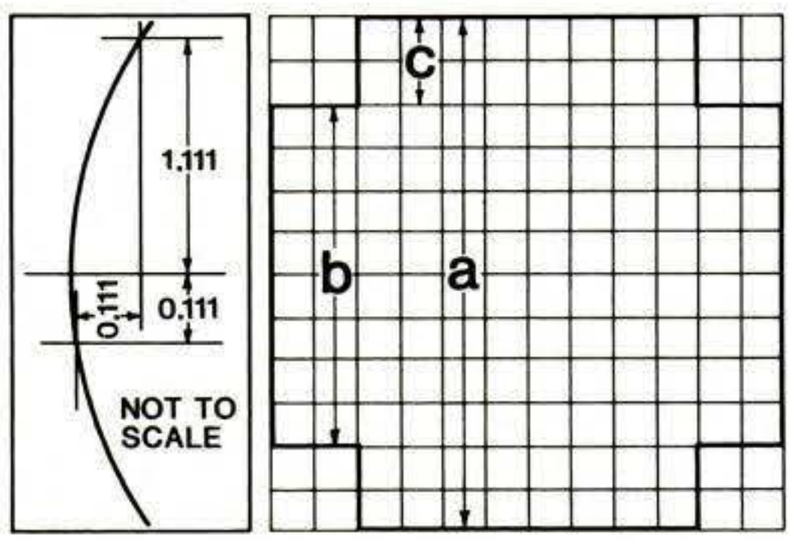
B. J. McCoy of Torrance, Calif., ran across this problem in the course of a shop project calling for milling eight precision slots on the face of a magnetic recording head. For three points on the perimeter of a circle (see drawing), you are given the horizontal separation of two and the vertical separation of all three. What's the radius of the circle? (For checking your solution without waiting for the next "Calcu-Letter," the first four digits of your answer should add up to 17.)

That folded box

The last column described a 13-gallon topless box or tank made by cutting away a square from each corner of a square piece of tin, then folding the sides upward. You were asked to calculate the smallest square with which this could be done.

With calculator at hand there's a trial-and-error approach that employs a minimum of math and fuss (see drawing). Calling the side of the original square (a) 100 percent and testing various combinations of $b+2c$ adding up to 100 quickly shows that the volume of the tank (b^2c) reaches maximum when a is 6 times c. Thus $b=4c$, and the volume is $16c^3$.

The volume is known to be 13 gallons, or 3,003 cubic inches. Dividing by 16 and finding the cube root gives the value for c; multiplying by 6 gives the side of the original tin square: 34.35 inches.



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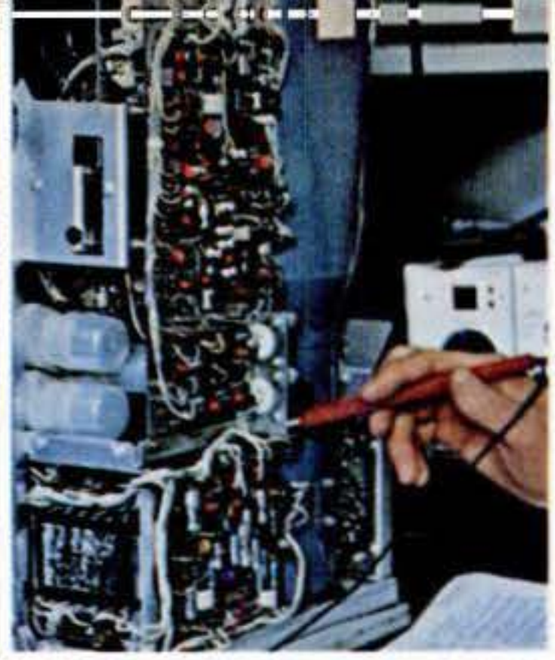
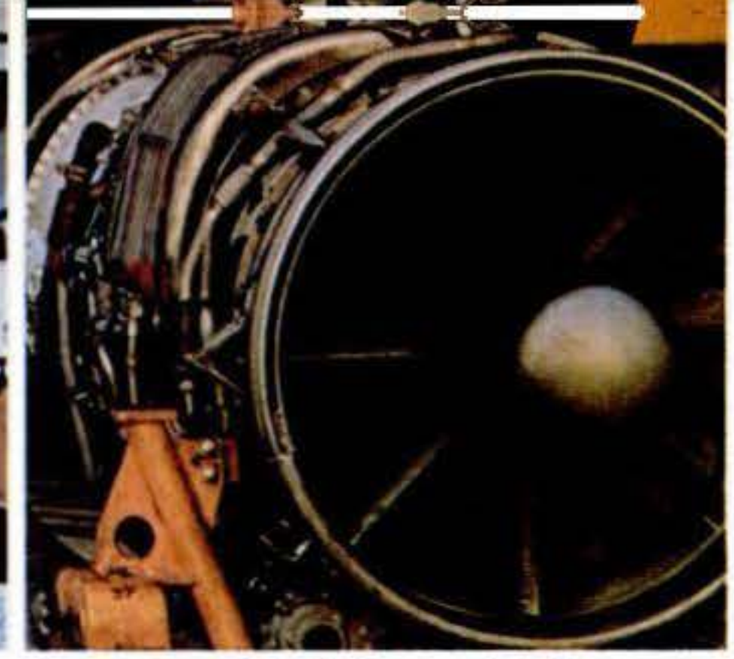

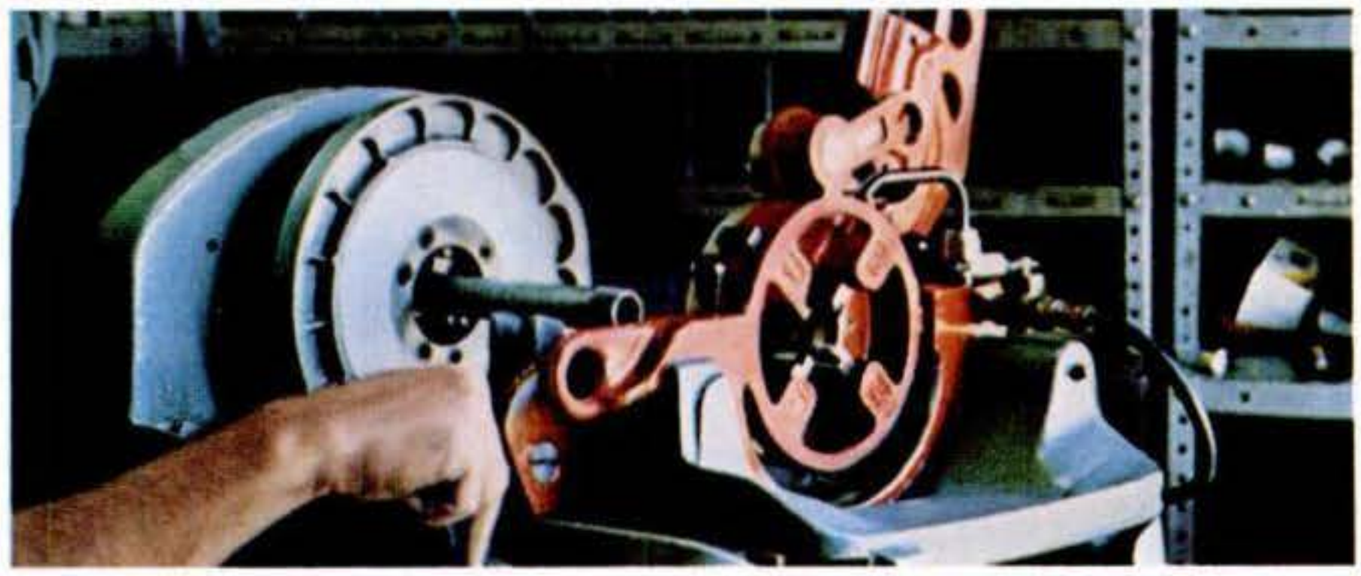

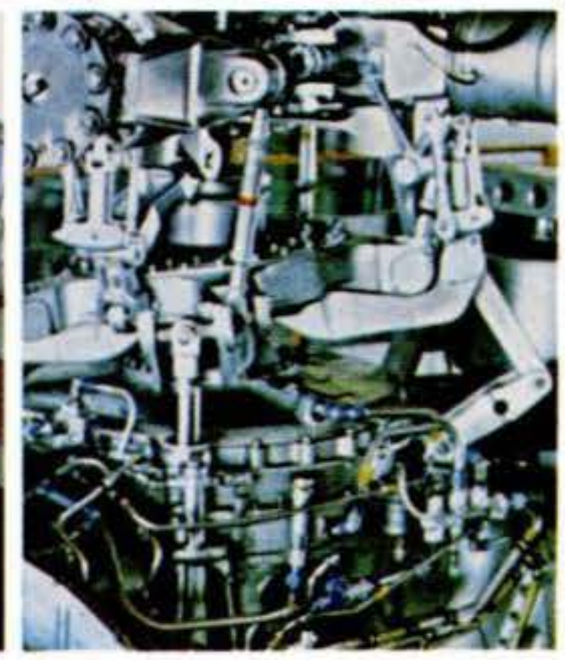

You're smart enough to graduate from high school. Are you smart enough to take advantage of these opportunities?

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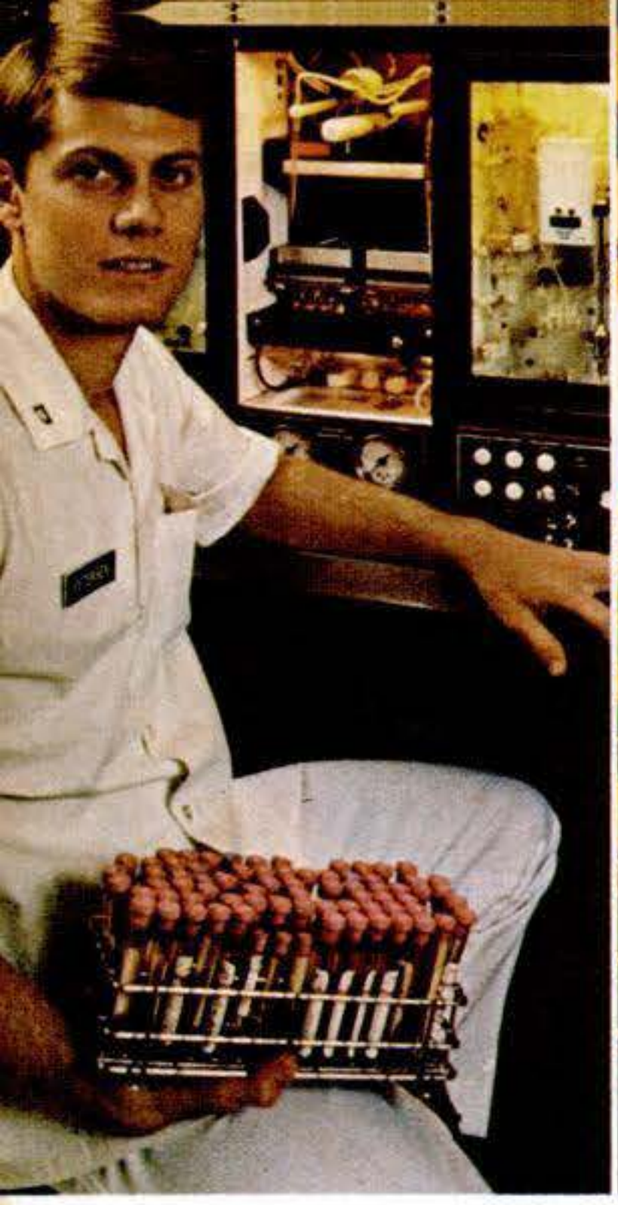
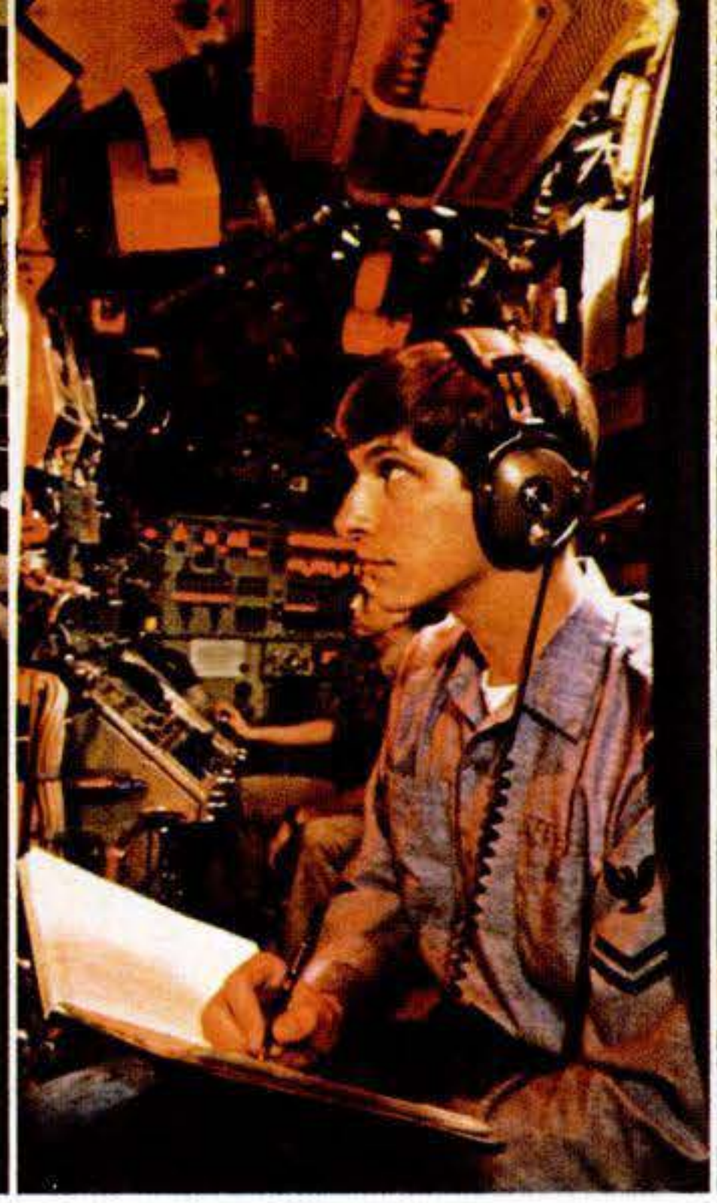

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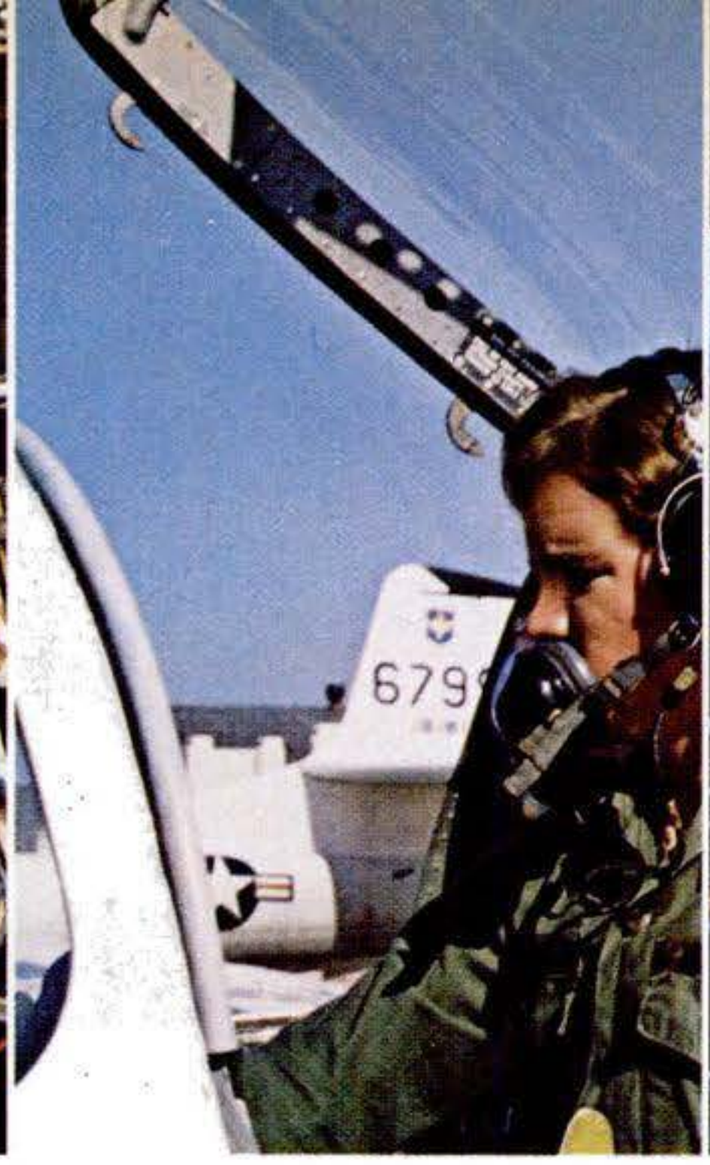
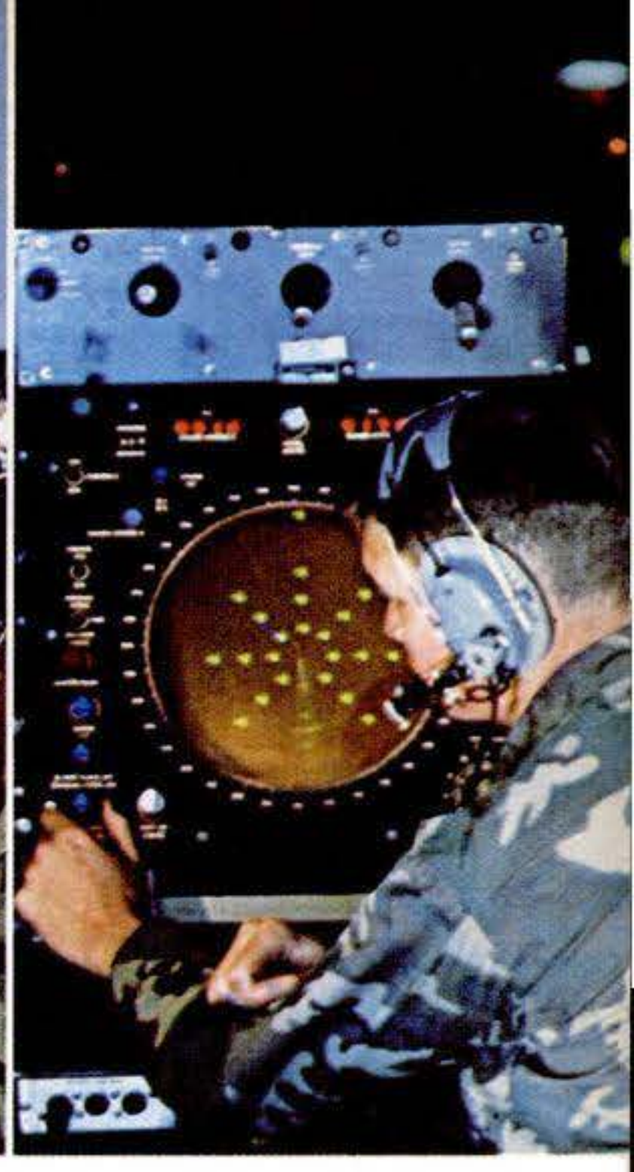

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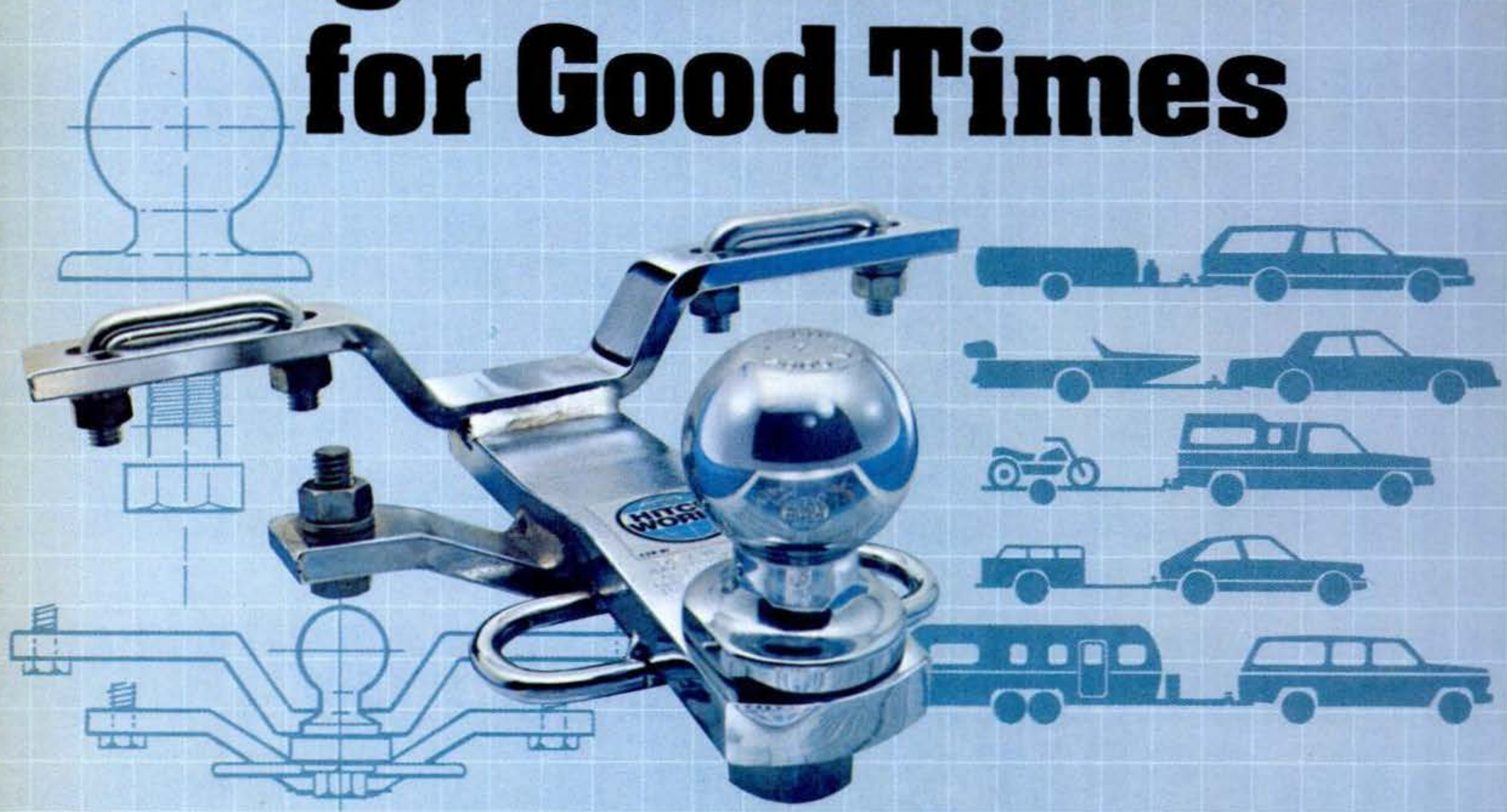

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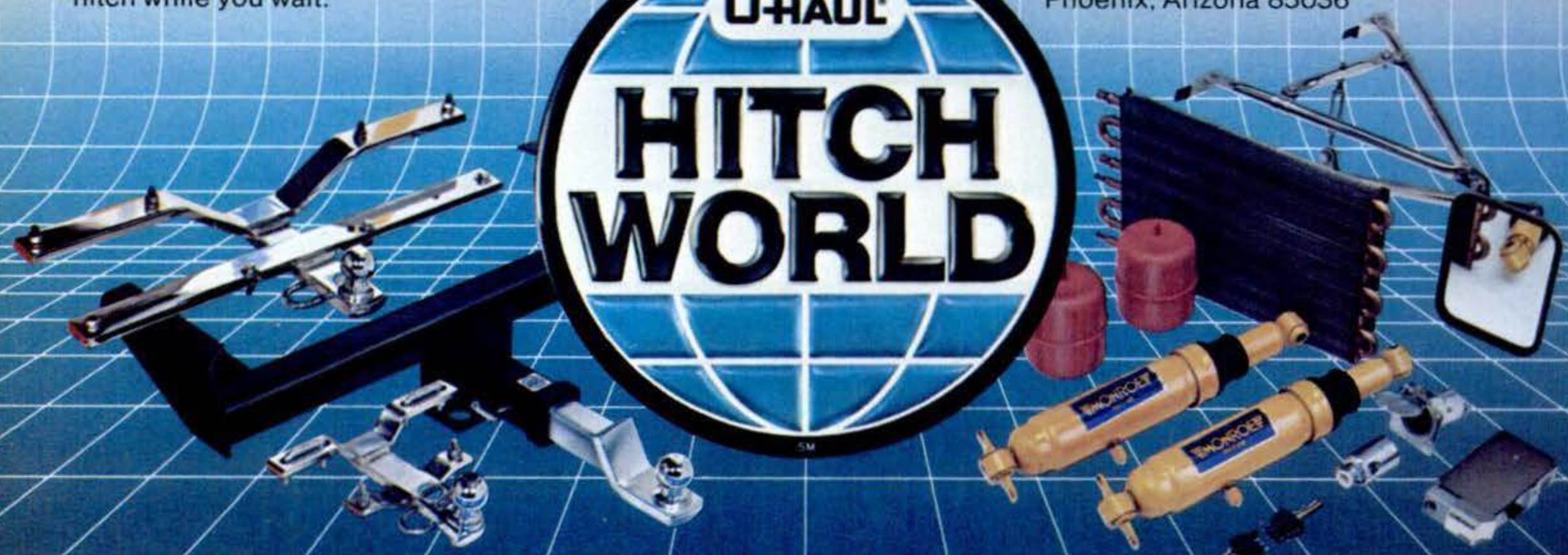

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DETROIT REPORT

By JIM DUNNE

P-car decision day

General Motors will decide next month the fate of the Pontiac P-car, the mid-engine sports car shown above in its latest version. Under development for two years and originally scheduled for production next month, the unique car has been beset with repeated delays, due mostly to factors unrelated to its own value. The latest hang-up is that Pontiac wants to build the P-car at its home plant, where it now builds the Grand Prix and Bonneville G-bodies. But it can't transfer G-car production out until a new plant is built, and the new plant's construction has been slowed in recent months, partly because of slow new-car sales. So the holdup of the new plant holds up production of the P-car. In the meantime, GM is re-examining its new-car plans, and the expense of building the P-car looks more and more deferable. My guess: Pontiac will insist on having the P-car and will get it in time for 1984 introduction.

Ford's big push

Starting next fall, Ford will introduce three new or restyled major car lines within the space of six months: LTD/Marquis, Thunderbird/Cougar XR-7, and the front-drive Fairmont/Zephyr. Styling will be substantially changed, with emphasis in just one direction—aerodynamics. The big-car lines of LTD and Marquis—which suffered sales declines in the last three years—will get smaller, though their big-car look will remain. Like most other Ford products, they will adopt the current rear-drive Fairmont/Zephyr chassis. That means that their length will be cut by more than 12 inches and curb weight chopped by a whopping 1,000 pounds.

Ford can't wait to make the planned changes in the Thunderbird/Cougar XR-7 line, whose styling has cost dearly in disappointing sales over the past three years. The introduction has been moved up from 1983½ to 1983¼, an indication of Ford's sense of urgency. Look for a hood line that dives downward from the windshield to the front bumper, a highly defined wedge shape for the rest of the body, but generally the same dimensions and drive train as the current cars.

After Thunderbird, things get even more interesting. At midyear 1983, Ford plans to introduce the compact "Topaz" line, which replaces the Fairmont/Zephyr. Changes will be dramatic. The new compacts will be among the most aerodynamic sedans built in this country. Hoods, fenders, and roof lines will slope precipitously. Front-wheel drive, transverse four-cylinder and V6 engines, and hatchback body styles will be among the surprises.

Chrysler's convertible

Chrysler plans to build 20,000 two-seat LeBaron roadsters this year, and they will be assembled in an unusual way. Original assembly will be in St. Louis; the cars then will be shipped to Brighton, Mich., where specialty manufacturer Cars & Concepts will cut two inches off the top of the windshield frame, shear off the sail panels and door-glass frames, and add the convertible mechanism. A stiffening steel spine will be added, along with additional stiffeners in the cowl, door-lock pillar, and trunk areas to make up for the loss of roof stiffening. Other detail work includes installing interior trim, putting in a new windshield, and adding a cap for the stowed top. Look for a pair of baby seats to be added to the rear compartment if Chrysler can figure out a way to avoid the federal seat-belt requirements for them.

Alliance or American?

The search goes on for a name for AMC's 1983 French-designed sedan (code-named X-42). Many alphanumeric combinations are being considered. But the best bet is AMC Alliance, though Renault American has a good chance, too. In Europe, where their cars are the biggest sellers, Renault officials can't understand why Le Car (R5) and 18i can't break into the lineup of top sellers here. So while Paris would like to see the Renault brand on the car, there are qualms about the reactions of American buyers. Another problem: AMC wants to hold its own christening; but Renault, which owns 46 percent of AMC, may insist on having the final OK. "And why not?" asks a Renault official. "After all, we may soon own more than half of AMC, and we should be concerned."

Six-port rotaries

The newest version of the intriguing rotary engine has extra intake ports in each rotor housing to boost fuel economy by as much as 25 percent. The engine is installed in Mazda's full-size Cosmo and Luce passenger cars. Rotaries have no valves, but rely on port locations in the engine for intake and exhaust timing. The latest wrinkle, the addition of extra intake ports, gives the engine a better timing schedule. The six-port design (three in each rotor housing) means less overlap of intake and exhaust, better power and efficiency. Look for the six-port idea to be offered on the RX-7 sports car, the only rotary-powered car available in this country.

Porsche picks Silent Shaft

Mitsubishi has granted Porsche rights to copy the Silent Shaft balancing system used on its 2.6-liter engine. The Silent Shaft has cam-like lobes, and spins in time with the engine. This sets up forces opposite to the inherent shake and vibration, thus cancelling them out. In Mitsubishi cars, Silent Shaft engines run uncommonly smooth, almost like a rotary. Porsche tried a number of other balancing ideas but decided that the Mitsubishi design was best, despite the royalty costs. Look for the Silent Shaft to show up in Porsche four-cylinder engines in the not-too-distant future. PS

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Little engine
powers eight yard tools

This clever import could cut your investment in power equipment

By A. J. HAND

The idea is far from new. Create a system of power-tool attachments all powered by a single engine and you'll save on money, materials, and storage space. Maybe so, but in the process you sacrifice some performance, convenience, and time.

Those were my thoughts when the new Solo Multimot system arrived in my driveway for a week of testing. I eyed the pile of cartons containing engine, lawn mower, chain saw, hedge trimmer, water pump, high-pressure pump and washer, string trimmer, and leaf blower, but I didn't see tools. I saw a long session of fiddling with wrenches, wing nuts, and balky motor mounts.

It didn't take me long to change my mind. By the end of the week I had been won over. The system isn't perfect, but it comes pretty close:

The engine: This is the heart of the system, and despite its small size and eight-pound weight, it beats strong and true. I found that the 1.5-hp engine had more than enough power for all the attachments. It's easy to start, runs smoothly from idle up to top speed, and has a velvety centrifugal clutch. The outside of the engine is fully jacketed. That keeps down noise and makes it virtually impossible to touch the muffler. You can pick up the engine and handle it without fear of getting burned.

But best of all is the motor mount. It can best be compared to the bayonet lens mount on a 35-mm camera. Changing attachments is about as quick and easy as changing lenses. It's so easy, in fact, that you don't even think about it (see photo and caption). While setting up a photo of the tiller, for example, it became covered with dirt. Switching the engine from tiller to high-pressure washer, to leaf blower, and back to the tiller, I gave the tiller a wash and blow-dry and got my picture in about three minutes.

The engine controls are convenient, too. With some attachments you preset the throttle at the engine by turning a knob. With others you control the throttle at the engine by turning a knob. With still others, you control the throttle via a trigger switch right on the tool. An excellent little engine. Price: $190.

Tiller/cultivator: This tool surprised me. Most tillers have engines with five hp or more, so I had visions of this

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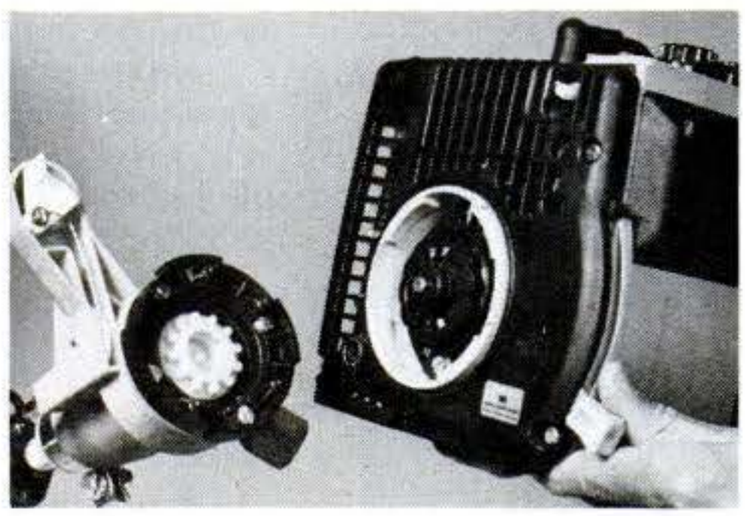

Multimot system includes (above, left to right) leaf blower, string trimmer, hedge trimmer, centrifugal pump, rotary mower, chain saw, tiller/cultivator, and high-pressure blower, all powered by 1.5-hp engine in the author's hands. Bayonet-type motor mount works smoothly (right). Place engine on attachment, press into place, and release the catch (under thumb). Flange on motor rotates automatically to lock mating flanges of motor and tool. Throttle linkages also engage automatically.

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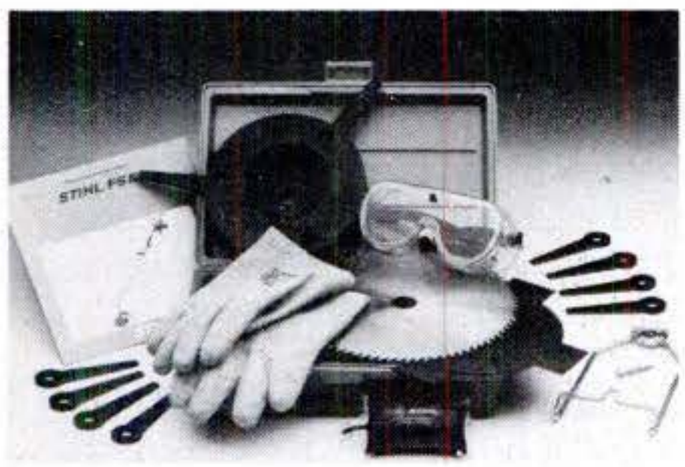

one bogging down and stalling. It didn't: The engine had power to spare. Of course, this is still a lightweight tool. I wouldn't use it for busting sod. But for cultivating or for tilling an established garden with good soil, the tool is hard to fault. The tiller has a grip-mounted throttle control, but I found it easier to preset the gas at the engine; tillers bounce around so much that it's hard to hold a steady throttle by hand. Price: $200.

Hedge trimmer: This rig performed flawlessly. I used it on yew, an overgrown holly, and some azaleas; it handled them all with ease. Balance is good, the trigger throttle has a safety interlock, the shut-off switch is right by your thumb, and there's a guard to keep your hand away from the blade. This is a safe, effective tool. Price: $95.

String trimmer: You wouldn't know this was part of a multipurpose system if I didn't tell you. The trimmer balances nicely, and comes with an elastic shoulder strap that I like better than the nylon straps that come with most trimmers. It's more comfortable and gives you great freedom to maneuver the tool.

A trigger on the handle lets you control the throttle, and the main grip is cushioned to isolate your hand from vibration. The engine has plenty of power to swing the dual-string head and cut a 12-inch swath.

One nit to pick: The head is the old-fashioned manual-feed type. You have to loosen a knob and pull fresh cutting line out by hand. An automatic or tap-feed head would be more convenient. Price: $110.

Chain saw: If I have any gripe about this tool, it's that its molded-plastic grip has some sharp edges that are hard on bare hands. Use it with gloves on, however, and that problem is solved. Then you can enjoy a smooth-cutting saw with a 10-inch low-kick bar and chain, automatic oiling, and plenty of power. Since the saw is made almost entirely of plastic, there may be a problem with long-term durability—especially in very cold weather. But I found no fault with the material during my tests. Price: $80.

Centrifugal pump: Hook up the hoses, prime it once, and the pump is ready to go. The spec sheet says the pump will deliver 1,300 gallons per hour at no back pressure, but in my tests with a strainer on the intake hose, I got only 600 or so. Maximum head—from suction line to the top of the outlet hose—is 65 feet. That's enough to handle just about any situation. Price: $90.

High-pressure washer: I've always wanted one of these to keep my tractor, mower, tiller, and 4WD clean. But the price has always scared me off. At $235, including the gun, this little rig seems like a bargain. And in my tests, it did a good job. I used it to blast accumulated grass from under my rotary-mower deck, clean sand and salt from the undercarriage of my 4WD, and even clean my back walk. I would, however, prefer a longer high-pressure hose so I could work all around a garden tractor or truck without having to move the pump.

Leaf blower: This is not the heavy-duty type of blower you would use to clear your whole lawn (see "Yard Blowers," this issue). It's a hand-held, trigger-throttle model intended for cleaning up around walks, patios, and landscaping. Like other blowers of its type, it has a long helper handle to direct the nozzle where you want it. But the jet blast is so strong I found I got better control by holding the air hose directly in my hand. Price: $60.

Mower: This 12-inch rotary is the Hovercraft type, designed to float on a cushion of air. Don't let your grass get much over two inches, however, or the mower will bog down and won't get off the ground. Solo says this tool is mainly for trim. It is very handy for that kind of work since you can move it any direction—even straight sideways—but you won't like it for general mowing. Price: $90.

Solo (Box 5030, 5100 Chestnut Dr., Newport News, Va. 23605) says other attachments are on the way: shredder/chipper, air compressor, brush cutter, vacuum, wheeled mower, and snow thrower.

The company claims that the Multimot system can save you more than 50 percent per attachment, once the cost of the engine has been absorbed. Some of the tools, however, seem better bargains than others. The power washer and leaf blower are good examples. The chain saw, string trimmer, and mower, on the other hand, can be duplicated in light-duty models—each with its own engine—at little or no extra cost.

The only practical way to evaluate the economics of the system is to decide which tools you want, then compare their total cost with the total cost of a set of similar single-purpose tools. If the Multimot wins the pricing war for you, I can recommend all the tools I tested except the mower. PS

Lightweight fuel-sipper

gets 56 mpg

Peugeot's experimental car —clues to future models

By JAN P. NORBYE

BELCHAMP, FRANCE

"You don't have to rethink the whole car to improve fuel economy by one-third," said Henri Saintigny, a test engineer at Peugeot's proving grounds. "This car—which we call Vera—has the same passenger compartment as the production-model 305 [not sold in America], and is the same overall shape, with the same general layout, but burns one-third less fuel."

How is it done? In brief, by taking lightweight construction to new lengths and by reducing aerodynamic drag through clever detailing.

I drove the Vera at Peugeot's vast Belchamp proving grounds and checked its performance for myself. Acceleration from zero to 60 mph took 14.4 seconds, and I reached a top speed of 97 mph.

The most surprising thing about the Vera is that it looks so normal. There's no rocket nose or stretched tail to spoil the Vera's looks and practical dimensions (just 170 in. overall). Yes, there is a rear wing, but it's there to prevent airflow separation and reduce tail-end lift.

Peugeot specialists worked in the St. Cyr wind tunnel to drop the car's drag coefficient (C_d) from a mediocre 0.44 to a laudable 0.318. To achieve this, they retained the standard windshield and rear-window angles from the 305 GL, but both are flush-mounted for smooth airflow. A front spoiler, integral with the bumper, is good for a 0.015 improvement in the drag rating by deflecting air and controlling its flow under the car.

The rear-door sills and fenders form fairings to shield part of the rear tires, while the rears of the front fenders are shaped like wide, smooth ducts to direct cooling air from the engine compartment along the sides of the car. Flush-mounted covers smooth airflow over the wheels.

The Vera drives like a normal car, too, although it is perhaps slightly noisier than the well-silenced 305 GL. No shortcuts have been taken with seating comfort or the smooth and well-damped ride, however.

Okay, but how about the weight reductions? "We knew we were going to save a lot of weight," Saintigny explained, "so we decided to use a smaller and lighter engine. That gave us additional, ripple-effect weight reductions throughout."

Peugeot chose the 64-cu.-in. (one liter) engine from the little 104 model (not sold in America, either) instead of

the 83-cu.-in. (1.3 liter) unit from the 305. Both are aluminum four-cylinder designs, but using the smaller block saved nearly 40 lbs. In addition, Peugeot fitted a lighter flywheel, an aluminum radiator, a plastic camshaft cover, a magnesium carburetor body, and a thin-sheet stainless-steel exhaust manifold, all of which saved another 35 lbs.

The engine was modified to make it more efficient than the standard 104 unit. The compression ratio was raised to 10.2:1, and the engine now produces 63 hp at a low 4,500 rpm. (The 305 GL engine puts out 65 hp, but at 6,000 rpm.) Engine torque was also raised, by nearly 19 percent, to 115 lb. ft. at 2,500 rpm.

Two camshaft bearings were eliminated to further reduce power-robbing internal friction. Lighter valve springs were installed, and camshaft timing was altered to minimize valve overlap. The engine was generally optimized for high torque at low rpm so it could pull the "longer" economy gearing of the optional five-speed transaxle from the 104, which was adopted for the Vera.

To lighten it, the body shell was made with high-strength steel inserts in critical areas, while unstressed parts were made of plastic or aluminum. Both left doors, for instance, are plastic, and both rights are aluminum, giving Peugeot the chance to simultaneously evaluate both.

The front bucket-seat frames are plastic, there's a plastic support bracket for the control pedals, and the brake master cylinder is aluminum. Experimental Michelin plastic wheels and low-profile TR-E tires save an additional 8½ lbs. per wheel assembly. Complete with fuel, oil, and water, the Vera weighs just 1,632 lbs.—408 lbs. less than the 305 GL.

How does all of the development affect fuel economy? In the European urban driving cycle, the Vera is rated at 37.3 mpg; at a constant 56 mph, 56 mpg; and cruising at 74.5 mph, 42 mpg. That's a full third better than the 305 GL sedan.

Peugeot makes it clear that the Vera is just a design study. It would be too costly to build, but you can expect features from it to show up on Peugeot models as early as 1983. PS

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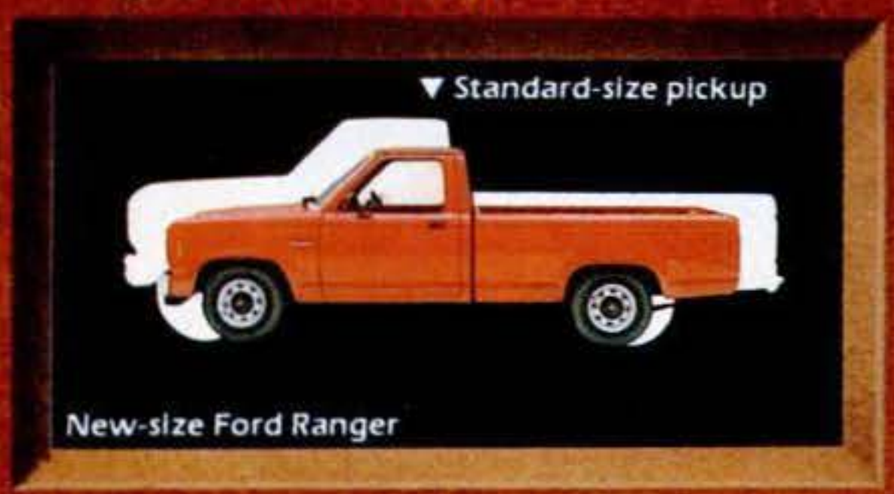
NEW-SIZE '83 FORD

Ranger XLT model shown



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39 EST HWY **27** EPA EST MPG

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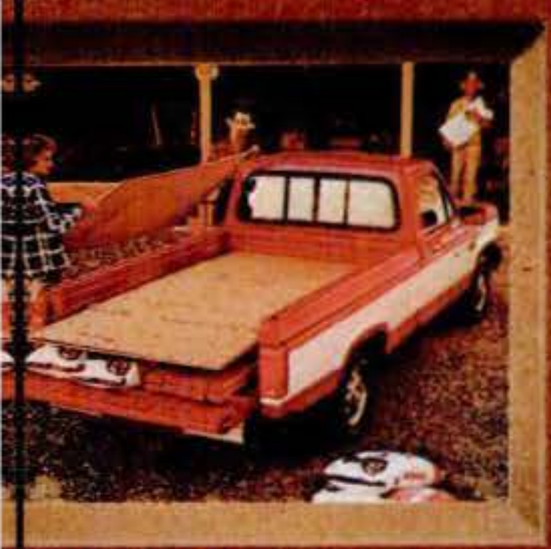

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See distant galaxies with a low-cost Dobsonian telescope

This large-aperture scope is rugged and portable, but it can't take time exposures

By GREG STONE

As my fingers fumbled with the focusing knob of the Odyssey 1, the distant M13 star cluster suddenly jumped into startling brightness. I gave an involuntary gasp. Not that anyone would have heard: It was 3 a.m., barely 12 hours after a colossal cardboard carton with "telescope" stenciled on it had arrived at my door.

I was on my backyard deck, having waited patiently for the sky to clear. Now I could get a look at some astronomical objects and assess the performance of the telescope's 13.1-inch mirror, try out the radically different mounting design, and see if the low-cost scope could live up to its advance billing. It had been touted as the first large telescope of practical design with a price within reach of the average amateur.

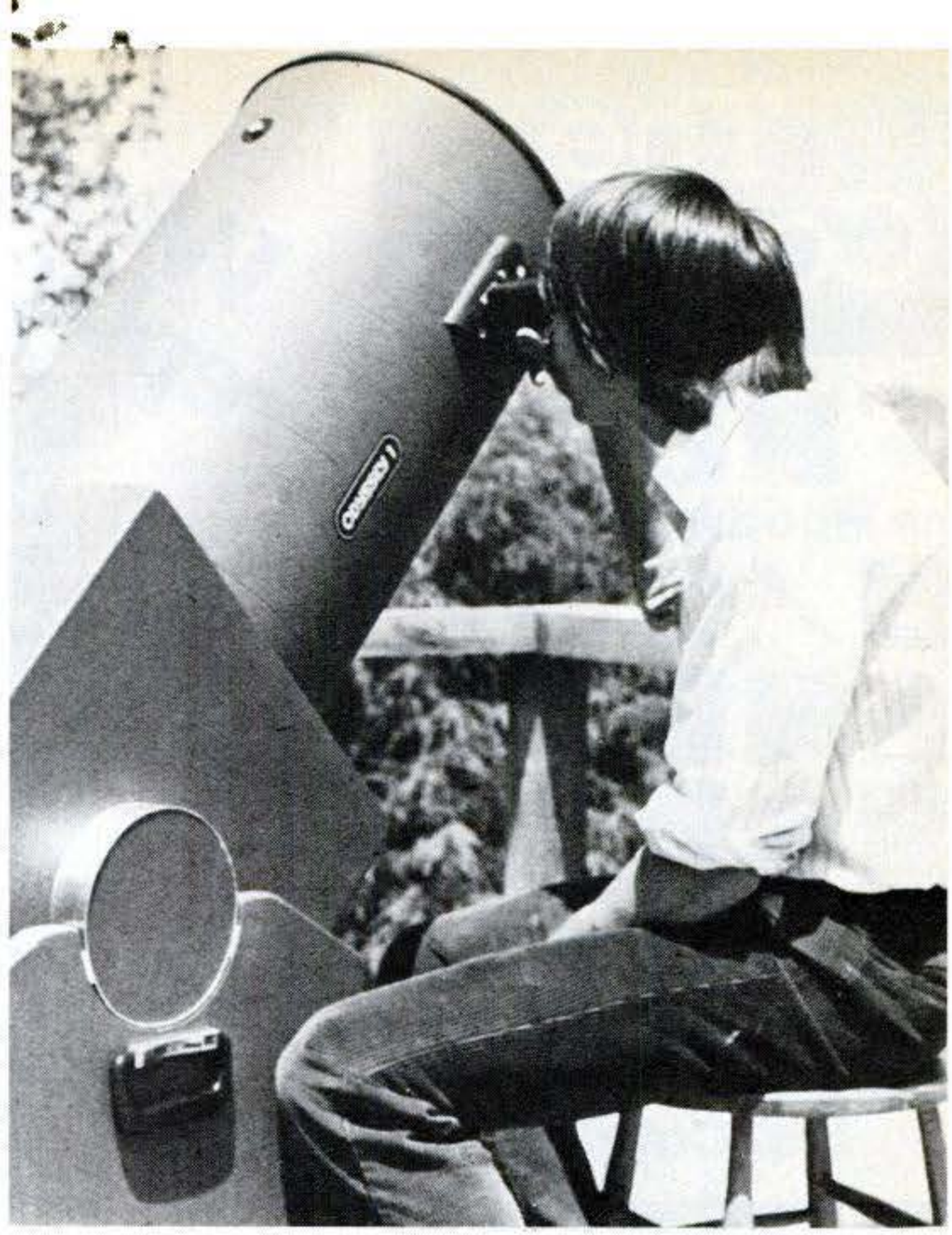
Although cleanly finished, Odyssey 1's stubby tube and boxlike Dobsonian (altazimuth) mounting make it look more like a circus cannon than a precision instrument. But in the dark you're looking through it, not at it. Then it shines. Or rather, it makes everything else shine. If you've never looked through an astronomical telescope, you'll have fun looking at Mars, Jupiter, and Saturn. But you'll probably have to make a cardboard stop to cut down the area of the mirror exposed to light: Under most conditions the unsteadiness of the atmosphere makes it useless to use more than six inches of aperture on the moon and planets.

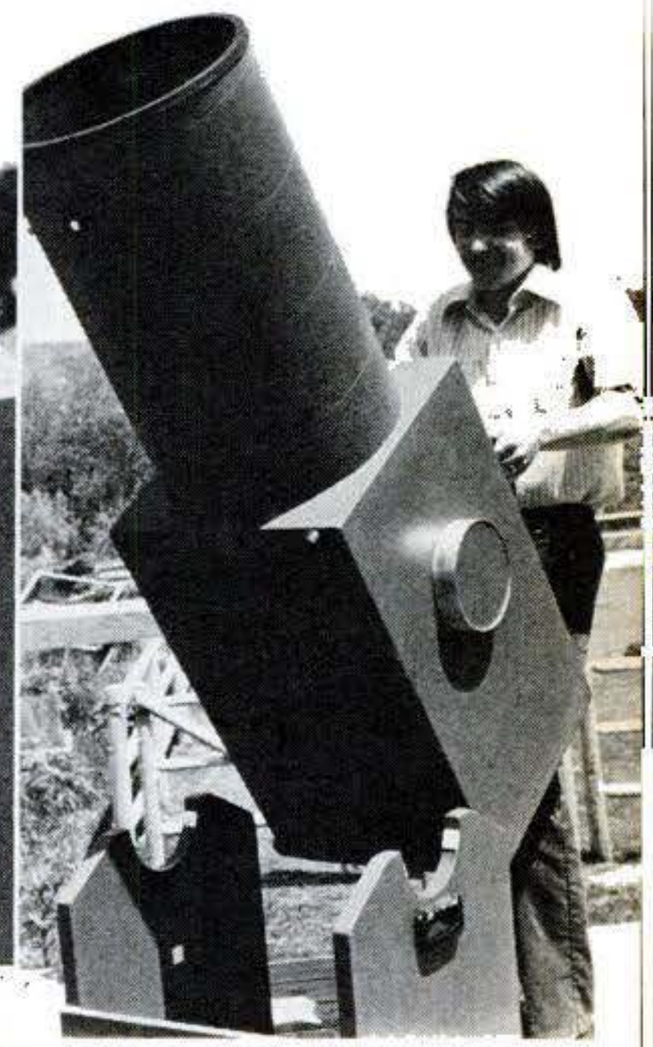
These aren't the real game for the telescope, though. What you want to hunt are the faint rays of the elusive Owl Nebulae, the shimmering blue-green gas cloud in Orion, and the dull glow of 100,000 million suns as they reach out from a galaxy millions of light-years away. M13, the object I first viewed, for example, contains about half a million stars all blending together in a mottled blur of light with only a small percentage of them distinguishable as individual stars. Light from these faint deep-sky bodies is collected very efficiently by Odyssey 1. Its 135-square-inch mirror surface acts as a large light bucket, and the more light you can gather, the deeper into space you can see.

But any good 13-inch mirror would do the same thing. It's Odyssey 1's extremely low price that makes it so unique. At less than $500, it is one-third the price of most other telescopes with the same light grasp. (And there are two low-cost sister scopes: the 10.1-inch Odyssey Compact and the 17.5-inch Odyssey 2.) To accomplish this feat, Coulter Optical Co. (Box K, Idyllwild, Calif. 92349) simply switched from the traditional equatorial mounting to an altazimuth design developed by John Dobson some 10 years ago.

Equatorial mounts are expensive, complicated affairs that allow you to track celestial objects by simply moving the telescope along the polar axis. What's more, you can attach a clock-drive mechanism that automatically tracks objects, allowing you to take long time-exposure photographs. The simpler Dobsonian mounting puts more strain on the observer than the equatorial mount, but a lot less on the pocketbook. The altazimuth must be adjusted by two axes, vertical (altitude) and horizontal (azimuth), and you can't take time-exposed pictures with it. But the smooth Teflon bearings make operation of the mount easy.

I've used equatorial mounts all my life and was skeptical of the Dobsonian at first. All things considered, however, Odyssey 1 is a fine amateur scope: It's rugged, transportable, inexpensive, and it works. PS





Telescope's sighting eyepiece (top) is at a convenient height for most purposes. You must remove the mirror (above, left) after each session by loosening two screws and sliding it out. Tube and mount easily break apart for transporting (above, right).

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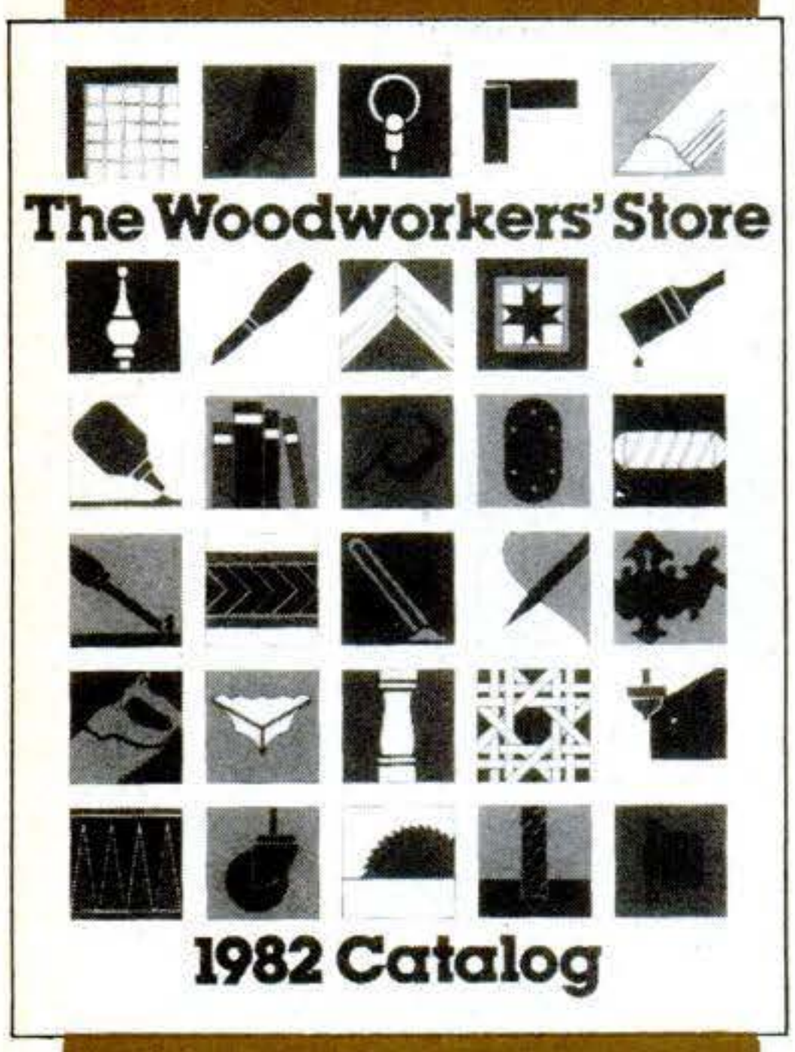

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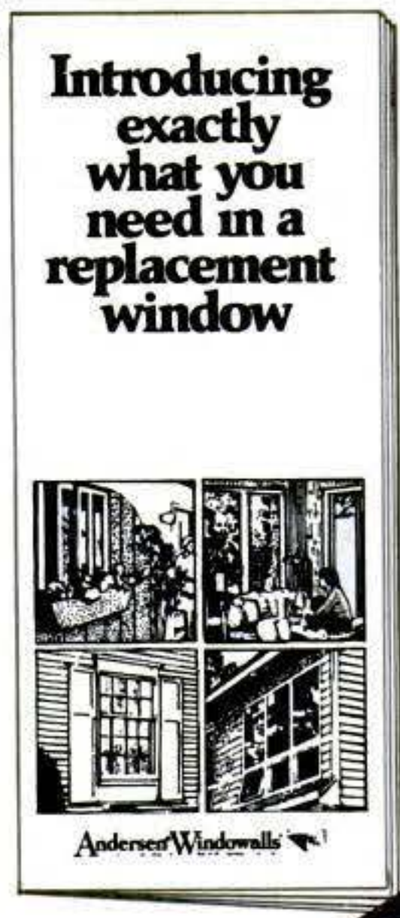

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Add-on combustor

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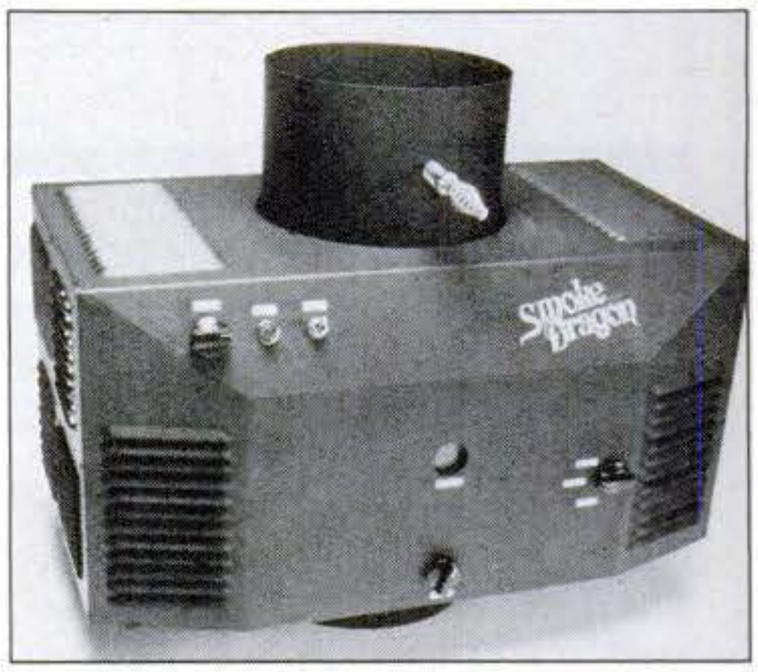

Stove atop a stove oxidizes unburned hydrocarbons in smoke from existing unit. Catalytic action boosts heat output, reduces emissions and creosote buildup.

Wood stoves with catalytic combustors burn hotter, cleaner, and safer [PS, Jan.]. But you don't have to trade in your present wood burner to reap those benefits. The Smoke Dragon retrofit catalytic heat exchanger will double an existing stove's heat output while reducing creosote buildup and particulate emissions, claims Penn Stove Co. (Mifflin County Industrial Plaza, Lewistown, Pa. 17044).

The $350 unit contains the primary components of a catalytic wood stove—combustor, bypass damper, draft-control damper, and observation port—housed in a stainless-steel heat exchanger that's made to replace the first section of existing stovepipe. It also incorporates a separate secondary air adjustment to provide oxygen for the combustor cell and a unique electronic bypass-damper control.

The combustor is the same Corning precious-metal-coated honeycomb disc used in most catalytic stoves, and, like those, it requires a preheating period before it will function. However, since this cell is located farther from the firebox than those in one-piece units, start-up time is longer. Penn recommends firing the stove for 10 minutes before turning on the Smoke Dragon.

In operation, the unit performs as a self-contained stove atop a stove, burning the hydrocarbons left in the smoke from the primary stove. The additional heat is forced into the room by an adjustable 140-cfm blower.—*Evan Powell*

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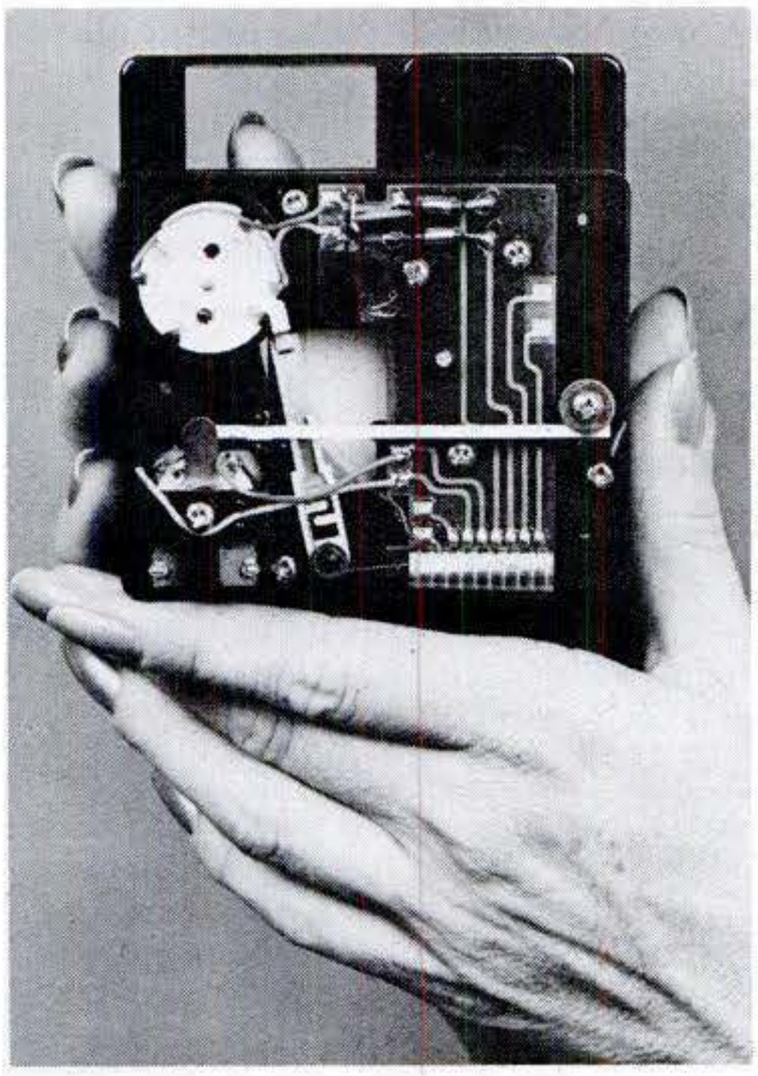
Talking Datsuns
get a bigger repertoire



The feminine voice was pleasing but insistent: "Right door is open . . . Right door is open." I leaned across the front seat of the 1982 Datsun Maxima and pulled the right door closed. The voice stopped, though I momentarily expected at least a "thank you."

The expanded voice-warning feature on 1982 Maxima, 200-SX, and 280-ZX models is a new version of the system successfully tried in the 1981 Maxima, which only warned you to "please turn off the lights." For 1982, there are six messages: "Parking brake is on. Right door is open. Left door is open. Fuel level is low. Key is in the ignition. Lights are on."

A microprocessor in the palm-sized unit controls the system, but the voice is provided by a miniature phonograph disc played on a tiny turntable. Switches placed throughout the car are monitored by the microprocessor, which is programmed with priorities in case more than one condition requires a warning. When needed, the microprocessor switches on the turntable, but then it switches on the radio speaker only to transmit the proper message. The cycle repeats every 4.5 seconds.

Nissan expects to continue expanding the voice warning in future years as drivers become accustomed to the audible warnings.—*Jim Schefter*

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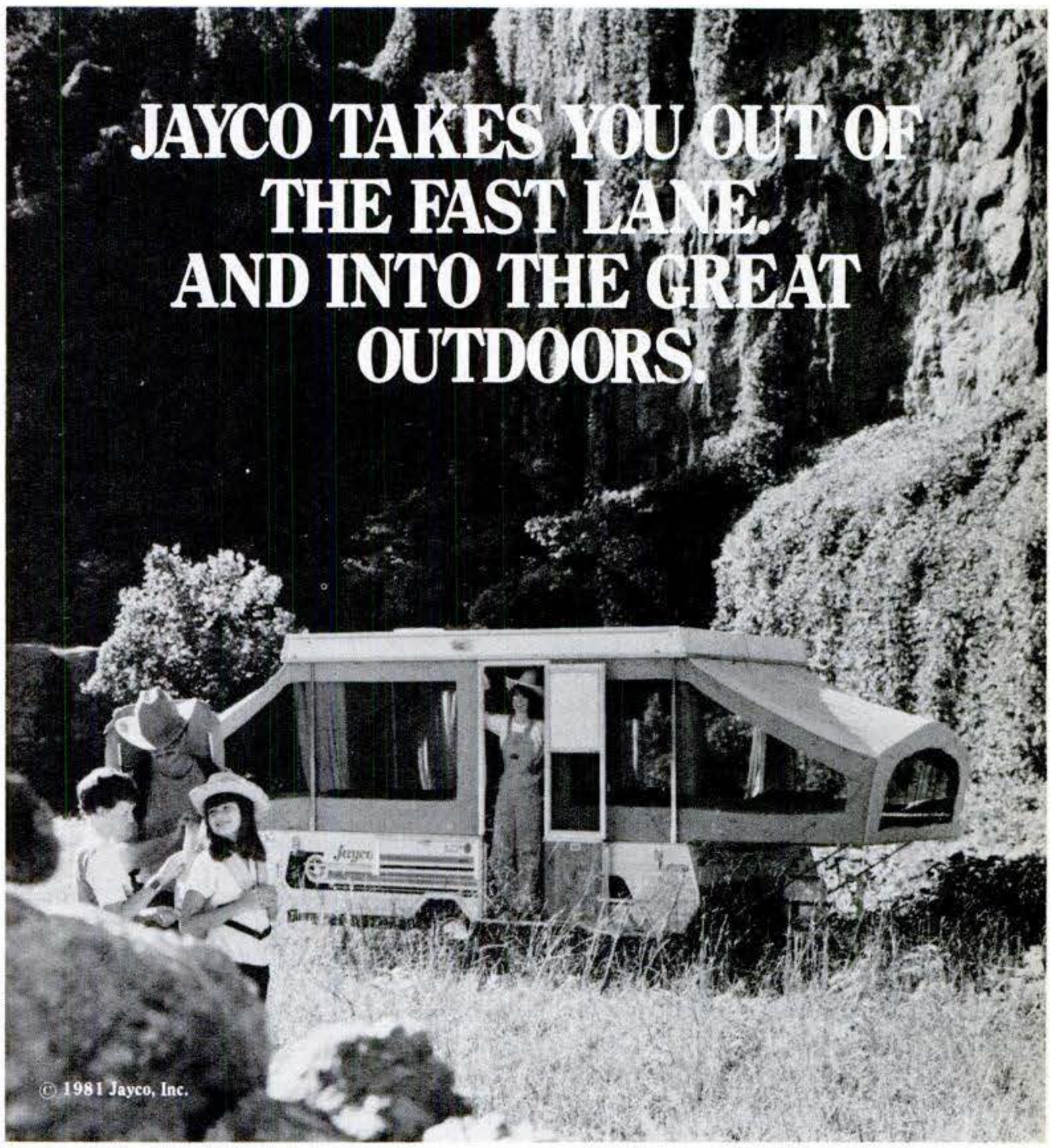

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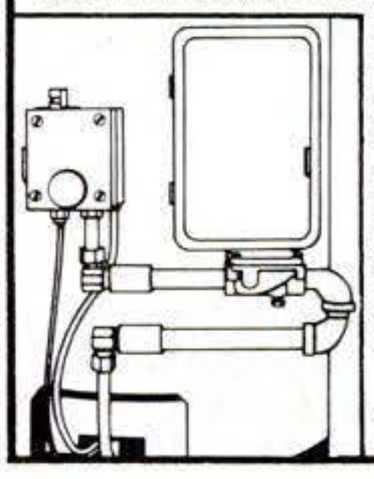

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Car dies

I have a 1975 Toyota Corolla with 97,000 miles on it. The car still runs very well—except occasionally it dies, as if the engine ran out of gas. I pull the car over to the side of the road and open the hood. I unhook the gas hose from the filter for three seconds and put it back on. I can hear air rush in when the hose is disconnected. Then the car runs well for a week or so. I've changed filters and cleaned the gas cap, but it still does the same thing. Can you help?

H. W. Barker, Middletown, N.Y.

Find out why your tank isn't vented and balanced to stay at atmospheric pressure inside. I believe the same thing would happen if you removed the fuel-tank cap. The tank is in a closed loop, and some tanks develop enough negative pressure to stop fuel-pump draw. Others pressurize and go rich. I sure wouldn't want a hot, pressurized fuel tank.

Clutch chatters

The clutch in my 1967 Camaro chatters when I engage it, especially at slow speeds. I have recently overhauled the 327 engine. It has a Saginaw four-speed transmission. I had the flywheel resurfaced and the flywheel, pressure plate, crankshaft, damper, and pistons weighed and spun-balanced. I installed a new pressure plate, clutch plate, pilot bearing, and throw-out bearing. I was careful not to let any grease or oil get on the flywheel, pressure plate, or clutch plate during assembly. I also made sure that all the seals were properly installed.

What should I do now?

Michael Leffel, Hendersonville, Tenn.

The biggest causes of chatter with a manual clutch are: incorrect or contaminated lining, uneven release of pressure plate, or bad motor mounts. I believe number two is your candidate.

Fuel-injection woes

Great cars, those Volkswagens with fuel injection. But when you get a "bug" in the system, you might as well pull all of your hair out at once to save the time and energy of doing it each time a new "fix" fails.

I bought a '76 VW Scirocco last fall. Initially I had a number of problems with the ignition, charging, and fuel systems. It was all fixed within the 30-day guarantee period—or so I thought. The dealer from whom I purchased the car turned out to be less than reputable and tried to solve my problem of a non-charging generator with an overcharged battery. The generator was eventually replaced—twice. From the start there seemed to be a relationship between the state of charge and idle speed. At high charge the idle almost fell to zero rpm and at low charge it zoomed to 2,600 rpm.

When I realized that the dealer neither intended nor knew how to correct this problem, I took the car to an authorized VW dealer for diagnosis and repair.

After a check of the CIS system, I paid for a new fuel pump ($175), fuel-pressure regulator ($150), fuel distributor ($200), and new set of injectors—plus $100 worth of other items. I was told that the fuel tank needs to be replaced, as the lining is flaking off and clogging the system. The problem is that the car is very difficult to start after its initial cold start in the morning. It does not matter how long the car runs or sits after this initial cold (and always successful) start. The problem is intermittent.

Should I invest in a new tank due to flaking or can I add a filter at the tank area to do the job of catching the contaminants? No one has had an answer for me.

Jim Miller, Howard Beach, N.Y.

Fuel-injection cars must have cleaner fuel than engines with carburetors. The smaller the engine, the more important this is (the orifices get very, very small). So you need a clean, stable tank interior, and a very good filter. Have the injector system cleaned and calibrated.

The questions are: Who has the equipment to do this? Should you buy a car that you can't have work done on? Should a car be sold that's this fuel-sensitive—without any practical repair options available?

Intermittent vibration

After 45 mph my 1978 Dodge Omni develops an intermittent vibration. The type of road makes no difference. I have had the wheels and tires balanced.

What should I do?

R. W. Skinner, Naples, Fla.

Have the accessories checked out: A/C, alternator, power-steering pump. Also check the motor mounts and exhaust system. Any of these can cause bad intermittent vibration.

Weird electrical problem

I have a 1975 LTD Landau with 460-cu.-in. engine, automatic transmission, and about every conceivable option (the car was a demo). The alternator light has recently started going on when I start the engine. When this happens, the air conditioner, turn signals, power windows, heater, radio, etc. will not operate. Sometimes the light will go out and everything will return to normal when I shift into drive or reverse. Other times I have to stop the engine and restart to get things working again. This problem sometimes occurs when driving in traffic. Do you have any ideas about the cause?

M. G. Haynes, Texarkana, Tex.

I can only guess. These things mostly end up being a bad ground. Try to find an automotive electrical shop and have the car examined. I suspect that one of the following grounds may be bad: engine to battery, alternator to battery, body to battery, or dash to body.

Wants overdrive kit

What do you think of the idea of installing the Ford "AO" overdrive transmission on my F-150 1975 Supercab pickup equipped with a 390 engine? I use the pickup as a traveling vehicle on highways with little or no loads. What would have to be done on such a conversion?

Steve Marecek, Altus, Okla.

It's a bad plan; it costs too much. There is no retrofit kit: You'd have to make the parts. If someone markets a kit later, it might work out if you were forced by major repairs on your present transmission.

Many people ask this question. The mileage improvement is there, but to recover your investment, even with the overdrive kit, would take many, many miles of travel.

Tire indentations normal?

I recently bought four Uniroyal steel-belted radials. After the tires were mounted on my car, I noticed two or three indentations running from the whitewall to the tread pattern on each tire. The dealer told me that this is not a defect, but merely depressions caused by the mold used to make the tires. He said many Uniroyal tires come with these depressions. Are these indentations truly mold depressions?

William F. Chimento, Whitestone, N.Y.

I have seen this on several makes of tires and have been told it's normal. But between the lines, I suspect they are working on production methods to get 'em straight.

Car mysteriously slows down

I have a problem with my 1978 four-door Chevette. When I'm driving down the highway at 55 mph, the car sometimes starts slowing down to 30 mph. And no matter what I do, it won't speed up. It will run fine for some distance, and then slow down. A Chevy dealer kept it for a week and, using a wrecked Chevette, exchanged almost every part from that engine with the parts on mine. But it didn't help. He ran it without the exhaust pipe

Continued

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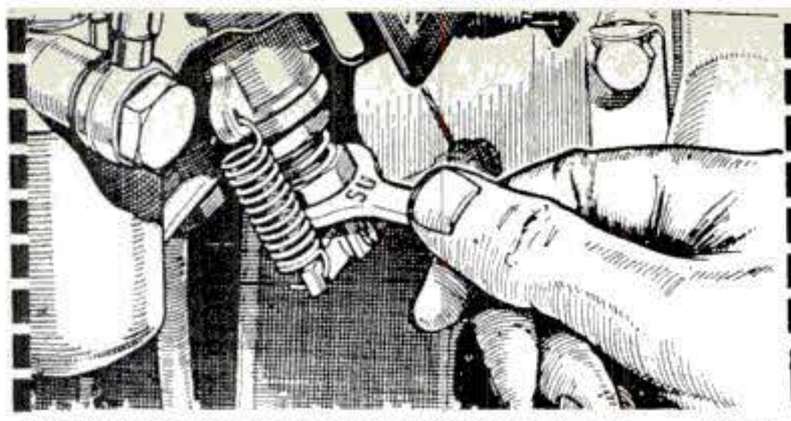

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and muffler—still nothing. He finally admitted that he was baffled.

Can you help me?

Fred A. Roscher, Hopewell, Va.

Pull the gas tank off. Closely examine the pickup and venting system.

Wants to modify

My 1975 Ford F-100 truck needs better performance from its 390-cubic-inch engine. It has dual exhausts with a crossover two-barrel carburetor, automatic transmission, turns 2,400 rpm at 55 mph, and gets 11 mpg.

I am interested in installing a non-symmetrical RV grind cam and porting the heads to achieve better performance. The first priority is to achieve better gas mileage. I want to stay away from manifolds and carburetors due to gains versus cost-effectiveness. What can I expect from these modifications?

Robert C. Berry, Hanford, Calif.

If you let engine rpm remain the same and want more mileage, you must get more heat in the combustion chamber, therefore more pressure for the same amount of fuel. A camshaft can help this. Porting at low rpm won't do much, except on the intake side.

Water pump keeps failing

I have a cooling-system problem on my 1979 Datsun 280-ZX. The car has 21,000 miles on it and to date the dealer has put four water pumps on the car due to leaks around the pump shaft.

In addition to the leaking water pumps, all the hoses and fittings have been tightened or replaced to stop them from leaking. It is my opinion that the cooling system is building up too much pressure, but I don't know why. The dealer, who has been more than generous and helpful, has gone over the cooling system several times and can find no reason for the condition.

Do you have any ideas why a new car would need so many water pumps in such a short time?

Peter R. Eisenberg, Morris Plains, N.J.

Have the pressure cap checked. It needs to release by the time pressure reaches 20 lbs. Fittings, hoses, pumps, and radiators suitable for cars should be able to stand 25 psi.

If your pressure relief is in the ball park and you leak anywhere, the parts or sealing systems, or both, are short. There's no other way to put it.

Wants to rework heads

I own a 1976 Cougar (39,000 miles) fitted with a 351 Windsor engine that is suffering from a burned valve and worn valve guides. I would appreciate your advice on my plans for repairing the cylinder heads.

I'm going to use K'line bronze guide liners rather than knurling the guides.

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Should I use a smooth or spiraled liner?

When remounting the heads to the block, could I use a thinner-than-stock head gasket, and compensate for the increased compression by installing a water-injection unit?

Duane S. Carlson, Jamestown, N.Y.

Use smooth guide liners, and hone the intake to 0.0015-in. clearance, and the exhaust to 0.002 in. Don't increase compression. You can't get fuel with an octane rating that's high enough. I don't believe you really want to get into a water deal.

Changed to colder thermostat

I replaced the 192-degree-F factory thermostat in my 1978 Pontiac Grand Am 301 V8 with a 180-deg.-F thermostat. What will be the long-term effect on performance, mileage, life of hoses, etc.? I drive 10 miles to work daily. Would a 160-deg.-F thermostat be even better here in southern Alabama for year-round use?

Ed Henson, Wagarville, Ala.

The hotter you run it, the better the mileage will be. Engine life will be about the same, although power will be down somewhat.

A lot of bull?

Recently, while riding along the highway with my radio on, I heard that somebody had discovered that attaching a "cow magnet" next to the carburetor on the gas line would increase gas mileage six to seven mpg. The fad is supposed to have spread to eastern states and now is out in California. Is there any truth to this? If so, where do you put them?

J. F. Gander, Boonville, Mo.

Was that a cow bell, or a bull bell?

I can see no way it would do anything unless by alchemy.

Oil confusion

I am confused about motor oils. In 1959 I bought a new Ford with a 352 engine. The mechanic whose advice I sought at the dealership recommended I always run nondetergent motor oil in it. I always did. Thirteen years and 140,000 miles later I sold the car. The block had never been opened and it was still running strong.

In '67 I bought a new '68 Volkswagen Beetle. The handbook says run HD SAE 30 in warm climates, and HD SAE 20W/20 in the winter. I did that for years. Then I said to myself, "If 10W/30 acts like SAE 10 when it's cold and SAE 30 when it's hot, why not run that all the time?" I did that for a few years. Then an auto columnist (I think it was you) stated that "Volkswagen does not recommend multiviscosity oils in their cars." So I went back to single-viscosity.

In '72 I bought a new '72 Buick. I have always run HE 10W/40. What is going on?

(1). Does VW simply neglect to recommend multiviscosity oils, or are they positively against its use? For what reason?

(2). Given the supposedly superior qualities of multiviscosity, why does anybody run single-viscosity?

(3). Why doesn't somebody write an authoritative article on this subject so us poor ignorant slobs can have a clue about what to use, in what, and under what conditions?

A. J. Moore, San Diego, Calif.

Things are changing fast. My advice is stick to the owner's manual. PS has done several features on oils in the last few years. Oil companies are working full bore on lubes, and today oil gets a lot of attention. I like a polyolester synthetic—one grade for everything. But nobody makes one that's fully tested.

Each month, Smokey Yunick answers questions on cars—family cars, high-performance models, and racing vehicles. Got a problem? Send it to: "Say, Smokey—", Popular Science, 380 Madison Ave., New York, N.Y. 10017. Smokey reads all letters, answering those he feels are of widest interest. Due to the large volume of mail, Smokey cannot reply to letters that are not answered in his column.

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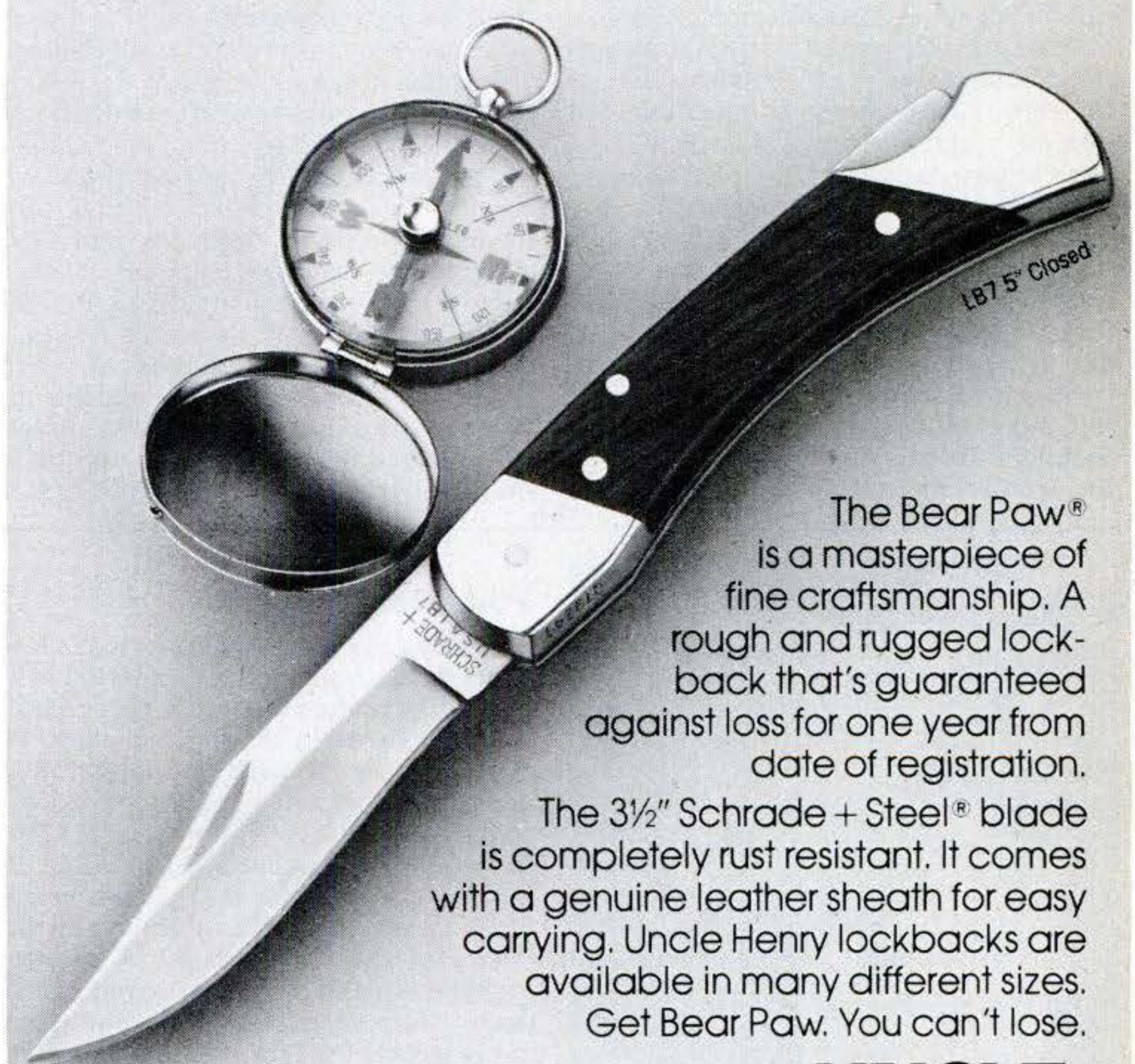

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RECREATION ROUNDUP

By HERBERT SHULDINER

RV fever

Since 1969, I've been attending the annual recreational-vehicle industry show in Louisville, Ky., and I've found it to be an accurate barometer of the industry's fortunes. In the late '60's and early '70's there was an almost unreal go-go quality about the shows. RV sales were growing almost exponentially, and almost anything that could be thrown together and put on wheels was sold as a camper. Remember that gasoline prices were low and there was lots of discretionary income in the U.S. Then came the first oil embargo in 1973, and the industry was plunged into gloom. Sales plummeted and half of the companies making RV's went out of business. Louisville was grim that year. So grim, in fact, that the president of one of the major RV firms glumly told me that he feared one of his firm's gas-guzzling motor homes standing in a driveway would become an "un-American symbol." Well, we got used to high gas prices and the industry turned around. Although it did not achieve the high sales marks of the early '70's, business boomed until the second major oil drought caused long lines at gas stations.

Based on what I saw and heard at the last Louisville show, the RV industry has hurdled that crisis and is now in another boom period. "We're building more motor homes than at any time in our history," Gene Stout, a vice-president of Coachmen, one of the largest of the RV makers, told me. Also surprising is Stout's report that big trailers are selling well in spite of the increasing fleet of small cars in the U.S. But the small-car increase is making some impact, Stout says, because sales of small fold-down trailers are also improving.

According to the Recreational Vehicle Industry Assn., there was a 38 percent increase in RV shipments in the first nine months of last year.

There don't seem to be any clear-cut answers when you try to analyze why this resurgence is taking place. Gasoline prices are still high. Interest rates are also at near record levels as of this writing, and unemployment in the automotive industry is at a crisis point. The latter has brutally affected the economy of the Great Lakes states, traditionally one of the best marketing areas for RV's.

As I see it, there are a few reasons for the current boom. People are buying big trailers and parking them permanently at campsites because it's a cheaper way of acquiring a vacation home than buying a cabin or leisure home. These big trailers have a surprising amount of living space and can be comfortable in all seasons. Secondly, there is a group of affluent motor-home owners who seek the kind of luxury associated with big cabin cruisers or small yachts. These buyers are well heeled and more immune to the concerns of high gas prices, inflation, and astronomical interest rates. A couple of thousand motor homes with prices pegged at $40,000 to $250,000 were sold last year, one industry source told me.

Lastly, I think life in an RV appeals to a large group of people who aren't interested in economy, as were many of the RV buyers in the late '60's and early '70's. RV vacations are more relaxed and allow a tremendous amount of flexibility in your movement. If the weather isn't to your liking, you can just steer your RV to an area where it might be better. Living in an RV also allows you to cook your own meals and enjoy the same things you would at home. And it isn't camping. Real campers load packs on their backs and head for the boonies.

Prospects for 1982

Chevrolet has emerged as the leading supplier of motor-home chassis to the RV industry since debt-burdened Chrysler abandoned this area. It sold over 12,400 motor-home chassis in 1981, according to M. H. Erdman, national truck-sales manager. "We are expecting about a 30 percent increase in the 1982 model year," he says. Erdman also predicted that sales of mini-motor-home chassis would amount to some 9,000 units in '82, about the same as last year. But he predicted a big increase in van sales because of renewed demand for van conversions. Erdman says Chevrolet expects to sell around 18,000 vans in 1982, compared with 10,000 in '81.

Part of the reason for Erdman's bullish forecast is the new 6.2-liter diesel that Chevrolet has introduced in its vans, motor-home chassis, and new S10 pickup (see "Diesel RV's," this issue).

Ford RV products on the way

Chevrolet's success in the RV market hasn't gone unnoticed by its biggest competitor; Ford has some big plans in this market. "Hopefully we'll have several new products ready late this year, in time for '83 models," says Robert C. Honke, Ford's RV-sales manager.

Included will be a new 8.2-liter diesel designed for motor homes up to 35 feet long with GVW's of 14,500 to 21,000 pounds. There will also be a 6.9-liter diesel for motor homes with maximum GVW of 10,000 pounds, Honke says.

Portable refrigerator

Recently, I tested a refrigerator that's ideal for tailgate camping. It's the new BiLan 25. The little unit has no motor, compressor, or fan. There are no moving parts. Yet plug it into a car cigarette lighter and it quickly cools down a couple of six packs, with room left over for other provisions, as well. What I especially like about the BiLan is an adapter that allows you to hook up to a standard AC power supply. That means you can take the fridge into a motel room and plug in, or use the power supply at a campground. But the power drain is only 2.3 amps, so you can run it overnight on your car's 12-volt system without causing starting problems in the morning. Made by BiLan, Inc. (412 Harrison St., Kalamazoo, Mich. 49007), its price is $189, including power adapter.

Wilderness trips

Want to go rafting in Hell's Canyon? Or horseback riding in the high Uinta Mountains? Or hike in the Alaskan wilderness? The American Wilderness Alliance (4260 E. Evans Ave., Suite 8, Denver, Colo. 80222) offers these and much more in its 1982 trip catalog. You can get a copy from the Alliance, which requests 50 cents to help cover postage.

Things to write for

You can get a free fishing atlas from Kampgrounds of America. The atlas lists 200 of the company's campgrounds that have fishing on the property—or within a 15-minute trip. Write to KOA, Box 30558, Billings, Mont. 59114.

"In a Time of Need" is a guide to the finding and recovering of drowning victims in lakes or other bodies of water. It's available free from Lowrance Electronics, Inc., Public Relations Dept., 12000 E. Skelly Dr., Tulsa, Okla. 74128. PS

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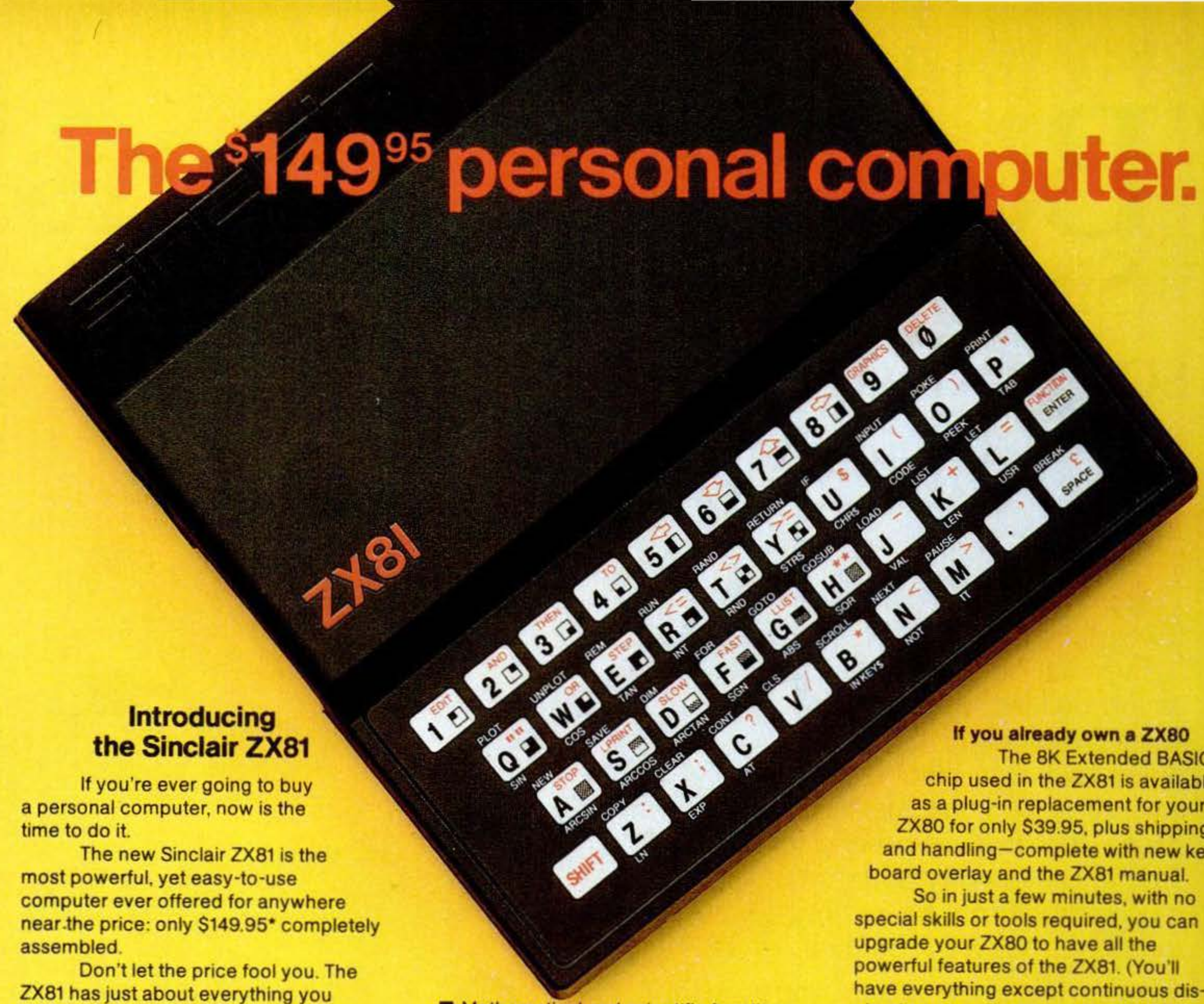

Introducing the Sinclair ZX81

If you're ever going to buy a personal computer, now is the time to do it.

The new Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only $149.95* completely assembled.

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The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

*Plus shipping and handling. Price includes connectors for TV and cassette, AC adaptor, and FREE manual.

If you already own a ZX80

The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only $39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

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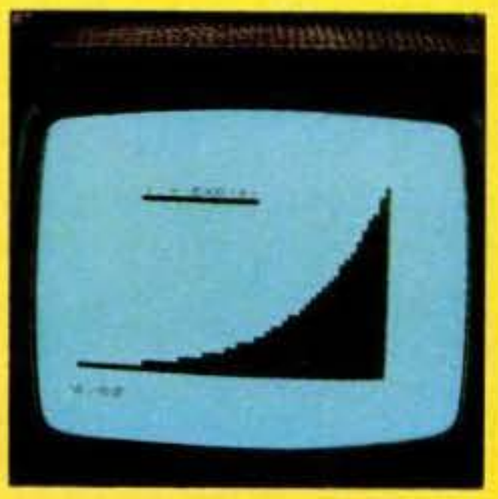

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Soft tubs
for cushy baths

When you step into the tub or shower, you're entering one of the most dangerous areas of the home—number 27 on the Consumer Product Safety Commission's household-hazards hit list, in fact.

That's why I was especially interested in the soft bathtub recently introduced by FacetGlas, Inc., 10 Blackwell St., Rock Hill, S.C. 29730. (A similar one, by The Soft Bathtub Co., Box 81125, Seattle, Wash. 98108, appeared in "What's New in Home Improvement," PS, Oct. '80.)

FacetGlas's Cushiontub is made of Ensolite, a closed-cell foam, that is backed by a shell of fire-retardant fiberglass-reinforced polyester (FRP). The skin is a tough vinyl. The result is a durable, slip-resistant tub that should drastically reduce accidents and injuries—and introduce a new level of comfort. The material is also a good insulator, so your bath water stays warm much longer.

Cushiontub's glossy skin is handsome, easy to clean, and resistant to punctures. If a puncture should occur, the repair is a DIY job.

The price is only moderately higher than that of ordinary tubs. Cushiontubs come in several configurations and can be fitted with whirlpools. FacetGlas also makes soft fixtures for the handicapped.—*Evan Powell*

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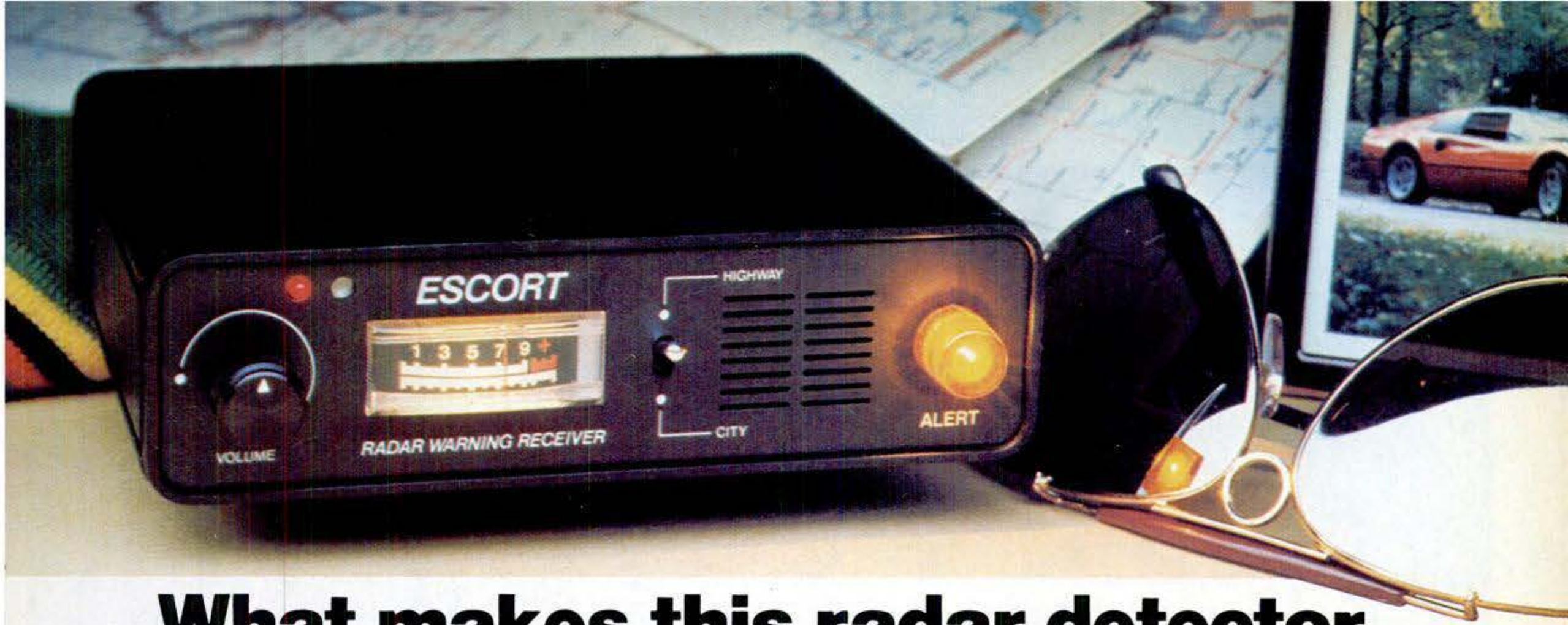

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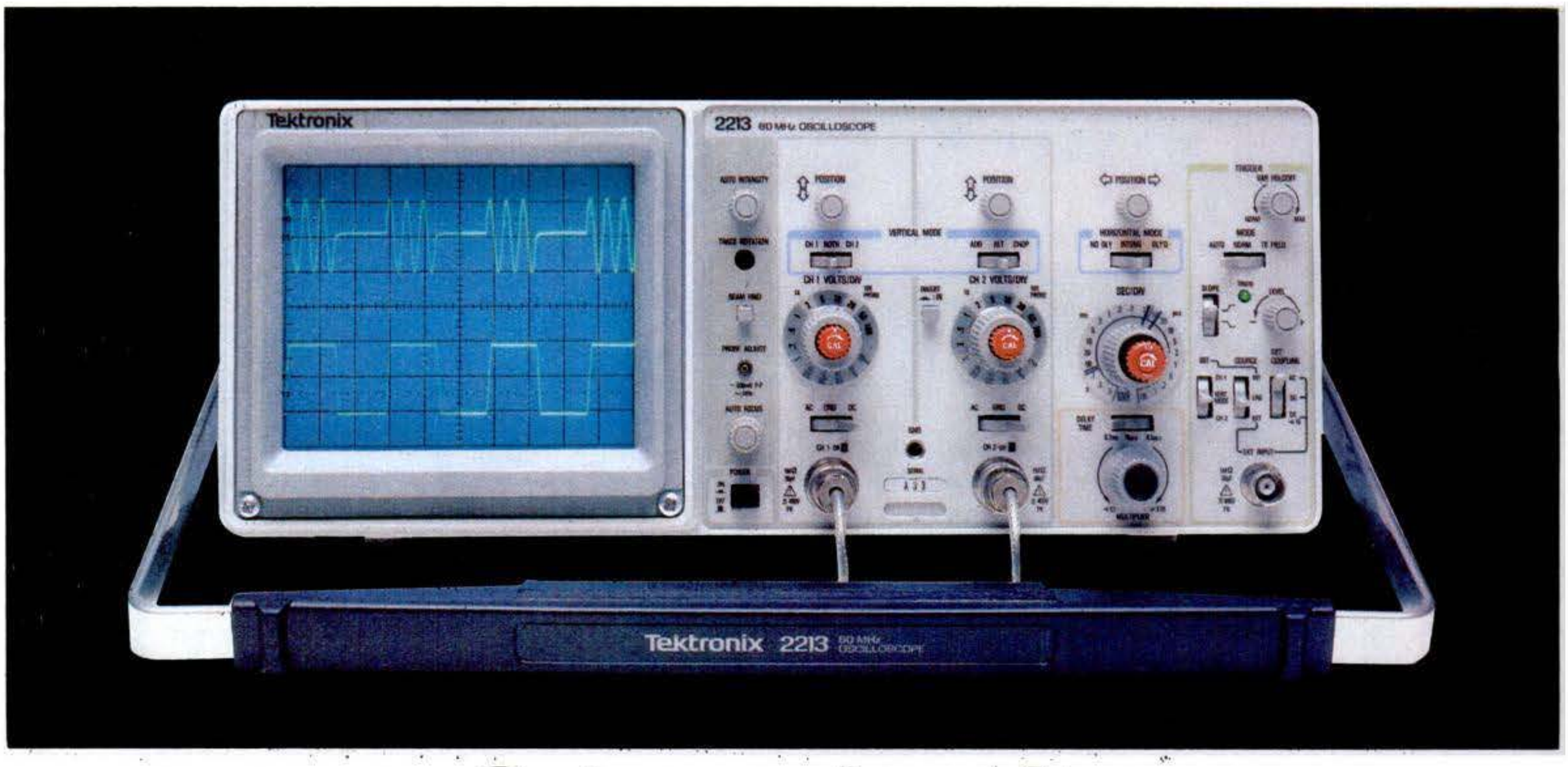

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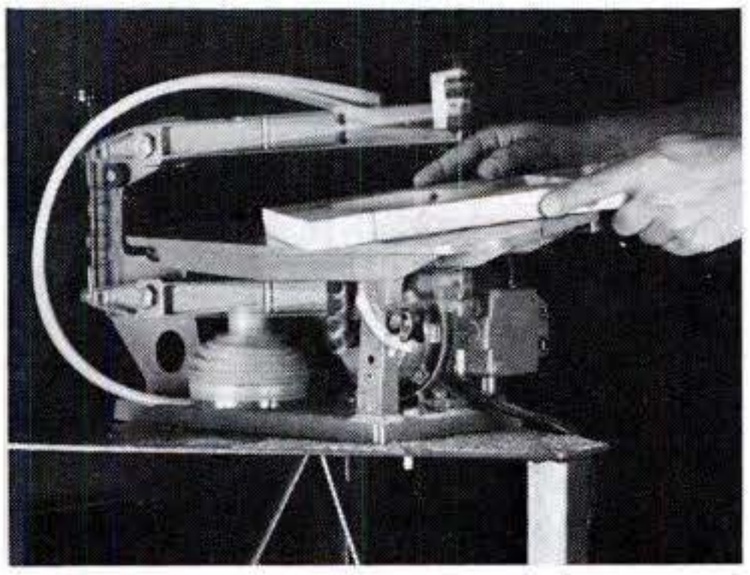
Pivoting-arm jigsaw



My old jigsaw was an unruly friend. The blades had a way of snapping off unpredictably, and the noise and vibration jangled my nerves.

Now I've found a cure for my jigsaw jitters: the Hegner Multicut-2, a German-made saw whose revolutionary design eliminates the clatter and worry of traditional models. It has an awkward-looking motion, a kind of out-of-sync jitterbugging. But it runs with little vibration and a safe, secure feel. And it's quiet.

More important, performance of the Multicut-2 is unsurpassed. The saw produces a smooth cut without any of the usual rough stroke marks.

The secret of this marvelous, versatile tool is its curious motion. The blade is held between two pivoting arms, which are joined at their opposite ends by an adjustable rod and spring. The blade itself is gripped on each end by a small V-shape clamp and secured with an Allen screw. These clamps rest in notches in the arms, and the blade is then tensioned by turning a knob on the adjustable rod at the rear. The motor drives the lower arm directly via an eccentric.

The purpose of this unorthodox arrangement is to keep the blade in tension at all times. Blades can be much thinner than a regular jigsaw's (which must be hefty enough to resist buckling when in compression on a return or "up" stroke).

Price of the saw, table, and hold-down is about $800 (A.L.I. Inc., 2735 Tanager Dr., Wilmington, Del. 19808). If you use a jigsaw regularly, it's worth it. The Multicut-2 is safer, more accurate, and your work will only need light sanding—so you save time. Who wouldn't rather cut, and cut well, than sand?—*Paul Bolon*

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Frugal flushers

Elegant water savers cost less than stylish water wasters

By SUSAN RENNER-SMITH

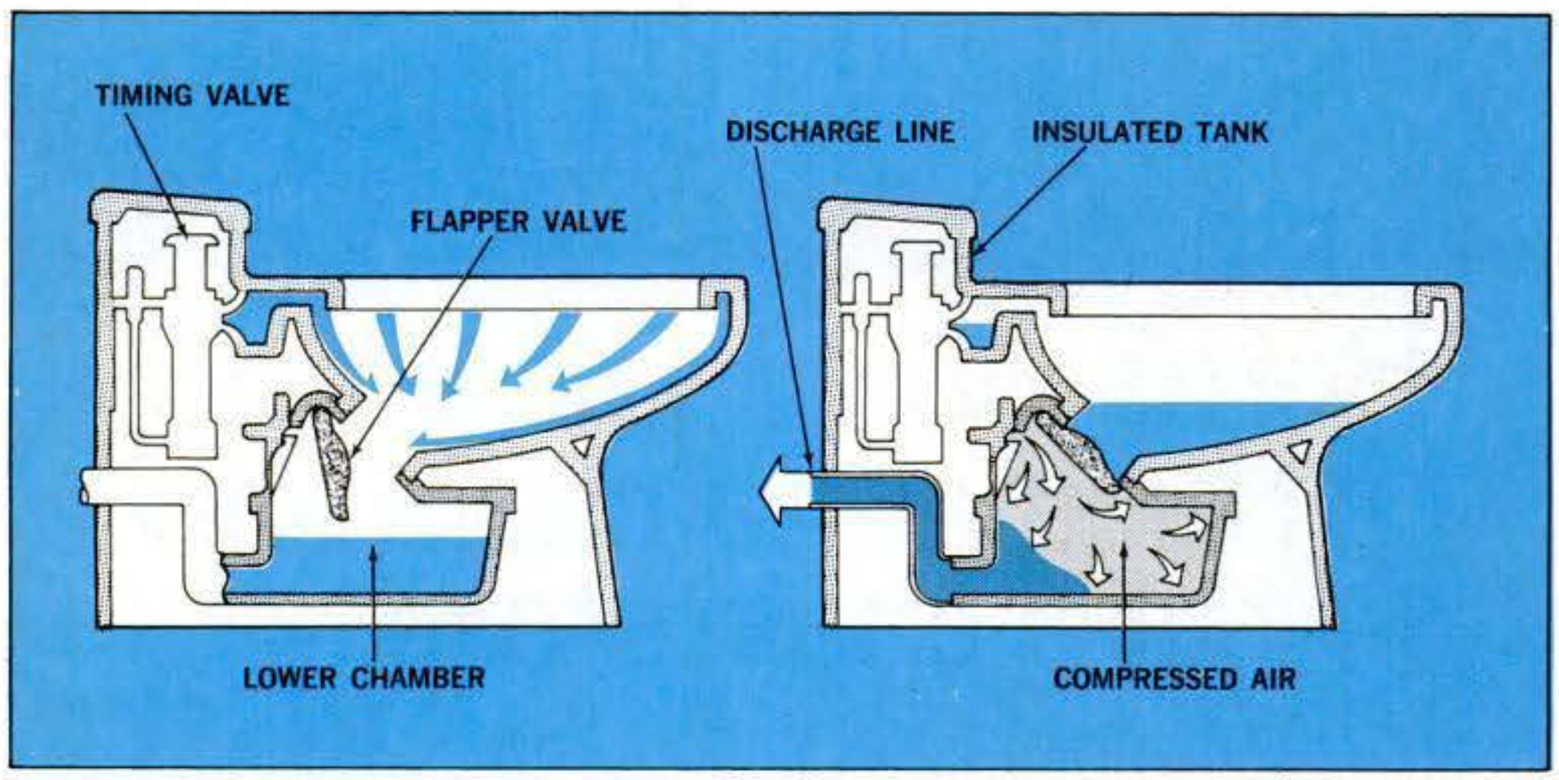
With water shortages plaguing communities across the country, conservation has become a national concern. Limiting water use may soon become an essential—and permanent—part of the American lifestyle.

These two new toilets could ease the conservation process. They combine water-saving economy with sleek, modern styling. One is an updated version of a water-saving pioneer; the other is the first all-plastic toilet.

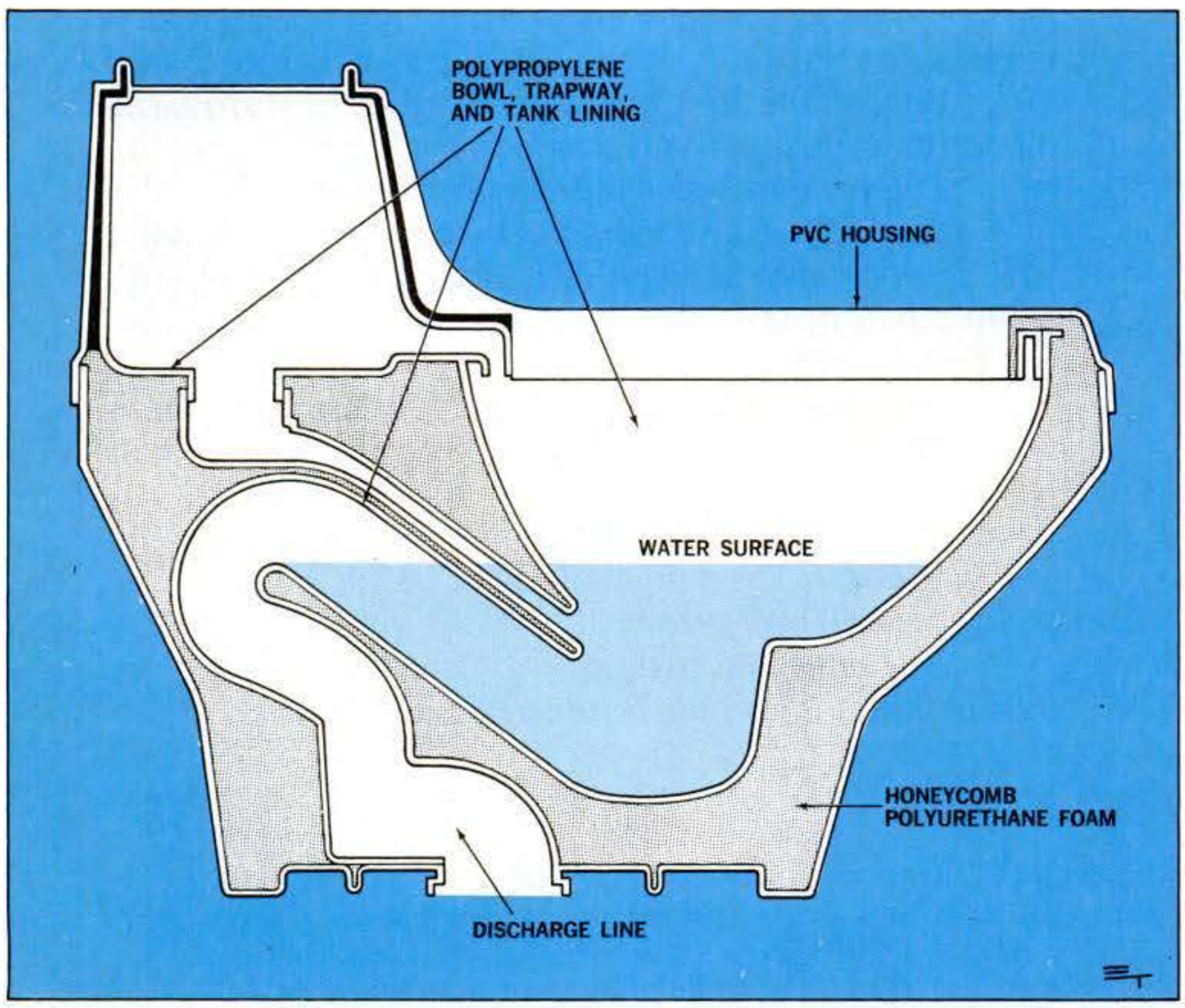
Though the Microphor toilet has been around for a few years [PS, Aug. '77], its frugal design is more newsworthy than ever. The toilet, which uses a miserly two quarts of water per flush, now comes in a stylishly low-slung version, dubbed the "California line" by Microphor (Box 490, Willits, Calif. 95490). The toilet costs about $375, without a compressor.

Compressed air is the key to the toilet's frugality. It both whooshes waste out of the toilet and converts it to a slurry that can be handled by conventional plumbing (see drawings).

A conventional ⅙-hp compressor, linked to the toilet by ⅛-in. tubing, will do the job. The compressor doesn't have to be in the bathroom; fitted with a manifold, it can do double duty in shop or garage. Since the Microphor sits on standard rough-in plumbing, it can be installed by the reasonably handy homeowner.



Thrifty Microphor toilet uses piston-type timing valve instead of ball cock to control water flow during flushing. Pushing handle opens flapper valve (above), emptying bowl into lower chamber. Rinse water enters around rim. Flapper valve then closes (right) and clean water fills bowl. Meanwhile, compressed air surges into lower chamber, forcing contents out rear—or downward—discharge line.



Molded into a seamless unit, the Delta 4000's bowl and trap have no joints to spring leaks. The foam core adds strength and muffles flushing noise. The insulated tank, a pricey option on most toilets, prevents condensation. Toilet can be installed by homeowner. It's said to be easy to clean: Swab with any bathroom cleaner.

Polyurethane-foam toilet

Though it works like a conventional toilet, the new Delta 4000 uses far less water than similar low-slung designs. It takes about 3½ gallons per flush; other one-piece toilets require five to eight. (Taller, traditional toilets with bolted-on tanks use from three to six gallons a flush.)

The reason behind the Delta's moderate water use? A precisely engineered seamless trapway makes clogging unlikely, so less water is needed, says the company (Delta Faucet Co., Box 40980, Indianapolis, Ind. 46280).

The Delta has another distinction: It's the first to have plastic inner surfaces (see drawing). A unique process combines three different plastics molded into a lightweight (29 lbs.) but strong unit that withstands 3,000 lbs. of static load. And at $250, the Delta (said to be stain resistant) is several hundred dollars cheaper than similarly styled china toilets. PS

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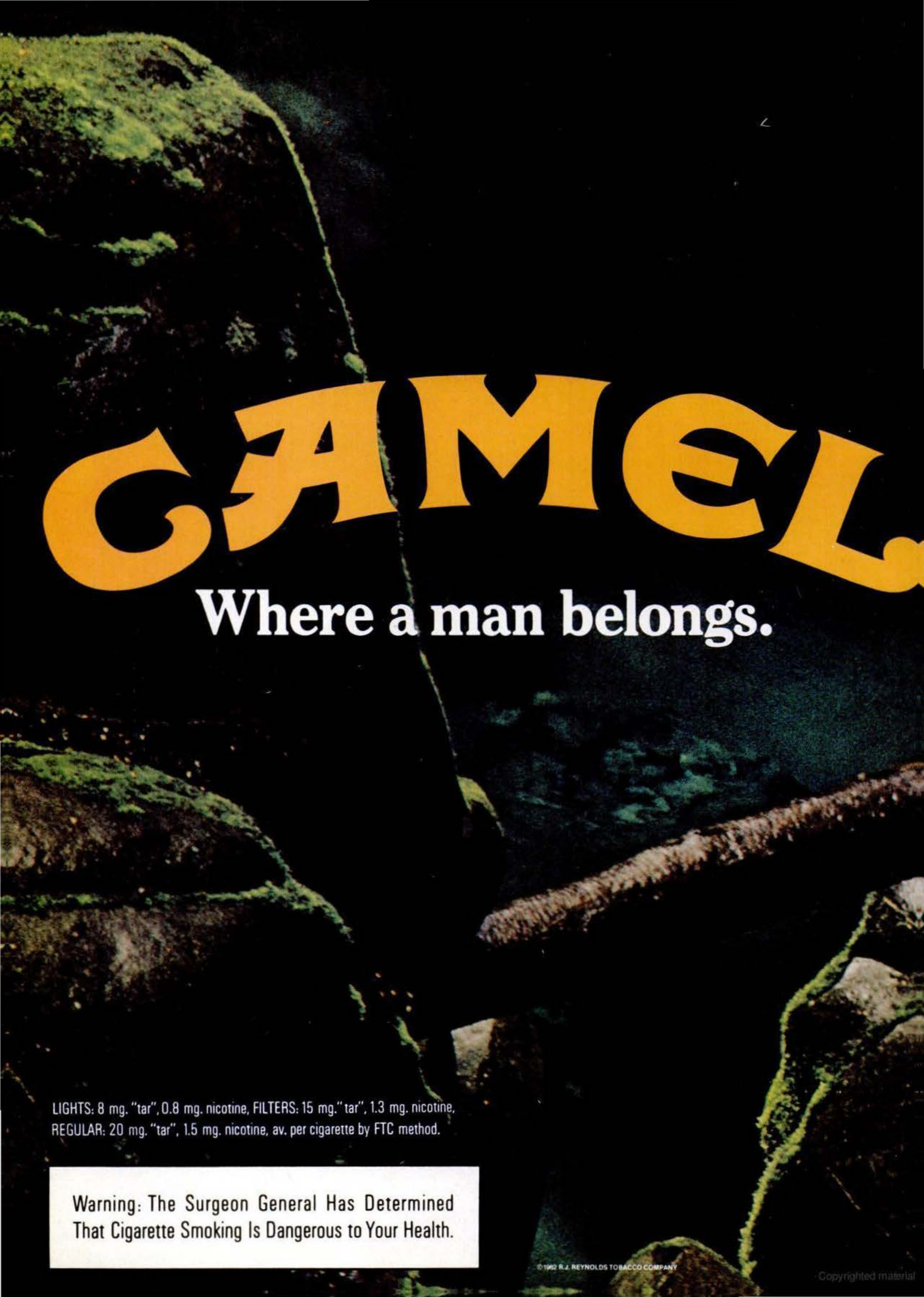

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Solar-heat storage system

solves an old problem in a clever new way

Phase-change salts with a high melting point, tricky plumbing, and direct heat transfer are the keys

By DAVID SCOTT

BRIGHTON, ENGLAND

Egon Helshoj picked up a shapeless, football-size lump of salt crystal. "This is sodium thiosulfate pentahydrate," he told me. "We call it hypo for short. It's the basic chemical in our fast-acting heat-storage system for solar panels."

Like the better-known Glauber's salt, hypo is a phase-change material, absorbing large amounts of latent heat as it melts and releasing that heat as it solidifies. Unit for unit, materials that change phase can store much more heat than can water (maintained as a liquid) or a rock bed, the two most common solar-heat-storage systems. That usually means both a dollar and a space savings.

Helshoj is managing director of Effex Innovation in Copenhagen, Denmark, and had brought his new solar-heat-storage system to the International Solar Energy Exhibition here. "This small one," he said, pointing to a five-foot-high cylinder, "could provide all the hot water for a house for three or four sunless days.

"Hypo has ideal characteristics for solar-heat storage," Helshoj continued. "Its thermal-storage capacity is exceptional, and it melts at a higher temperature than Glauber's salt: 48 degrees C (118 degrees F)—high enough to provide hot water and space heating, yet not too high for normal collector panels to tolerate.

"Until now no one has used this salt because of some undesirable physical changes that occur during the melt/freeze cycle," he explained. "But we've solved that in a simple way."

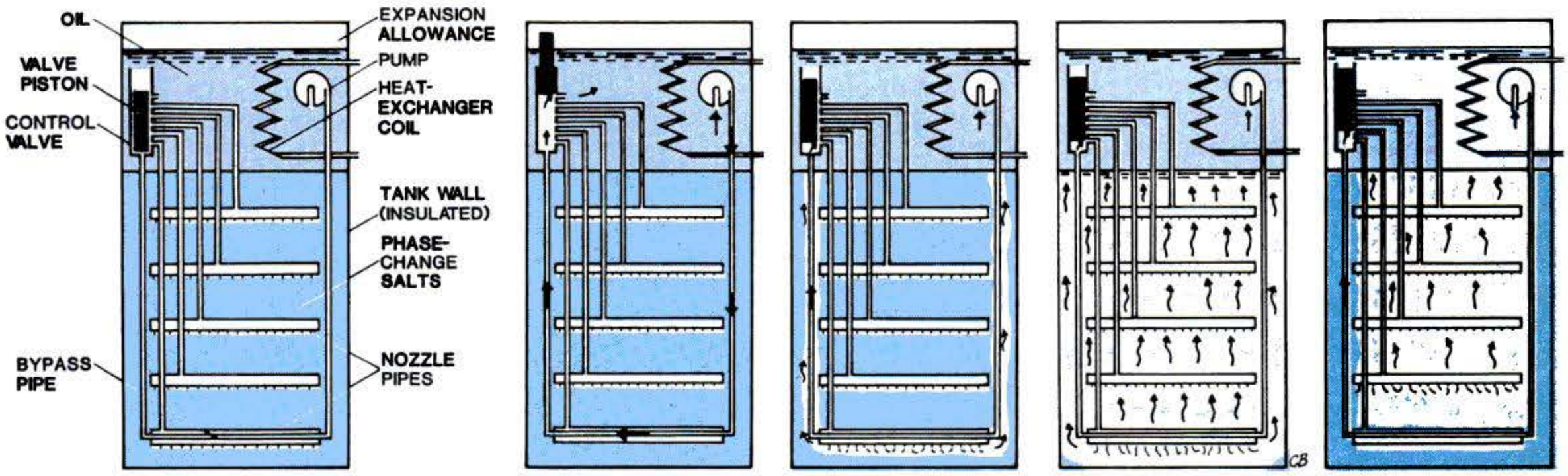
The Effex rig combines a heat-exchanger coil in the solar-panel and domestic-plumbing circuit with a tank of phase-change salts. The usual snag in such a system is that as the salts gradually solidify when latent heat is released, the crystals cling to the surface of the coil, building up an insulating crust. This soon stops further extraction of heat.

While there are mechanical solutions to the problem ["Revolving Barrel Banks Solar Heat," PS, May '78], Helshoj has come up with an elegant, nonmechanical answer. He uses oil as a two-way heat-transfer medium between coil and salts. The special mineral oil, an immiscible fluid, is pumped through the molten salt.

Since the oil's specific gravity is lower than the salts', the oil rises to the top of the tank where the exchanger coil is immersed, and transfers the absorbed heat to it. A crafty multilevel arrangement for dispersing the oil through the salt solution beats the crusting snag. The drawings show how it works.

"This oil-feed arrangement plus direct salt-to-oil contact speeds the heat-transfer action," says Helshoj. "That means that fleeting bursts of solar warmth are captured, and even small reserves of heat can be extracted—and quickly."

After the Brighton exhibition, the hypo system was to be tested at the Danish Technical University. PS



How it works: Heat-storage unit has five nozzle pipes in salt tank. When tank is fully discharged (first diagram, left) salt crystals block all nozzles. Second diagram: Charging begins when hot water, above 48 deg. C, from solar collector circulates through heat-exchanger coil, warming thermal oil. Electric pump starts, pumping oil via bypass pipe (inside lowest nozzle pipe) up to simple automatic distribution valve. Pressure lifts piston to its highest position, opening top outlet to circulate oil. Third diagram: Heat from bypass pipe melts crystals blocking bottom nozzles, opening oil passage from lowest valve outlet. The resultant pressure drop makes the piston fall to that level. Oil flow through the cleared nozzles causes further local melting. Crystals around vertical feed pipes also dissolve. Fourth diagram: Soon all the salt melts and the storage tank is fully charged. During this time the valve piston stays in the same position. Discharge occurs when a cooler liquid, such as from home radiators at start-up, circulates through the heat exchanger. Oil chilled to below 48 degrees C initially circulates, causing tiny crystals to form in the solution. They rapidly increase in number and size, releasing latent heat, though the temperature remains constant. The heat is picked up by the oil and transferred to the liquid in the heat exchanger. Fifth diagram: Heavy crystalline slush sinks to the bottom of the tank and solidifies, first blocking nozzles in the lowest pipe. As pumping continues, back pressure in the oil-control valve lifts the piston to the next higher outlet, opening an oil passage to the second nozzle pipe. With further cooling a solid mass builds up, progressively blocking the higher nozzles. At each stage, the piston rises until full discharge is reached. The pump then stops and the piston drops.

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3-cylinder turbodiesel

delivers 70 mpg in a modified Rabbit

VW's fuel miser is slimmed and revamped to boost economy by 37 percent

By JAN P. NORBYE

PS Automotive Editor Jim Dunne reported in November 1979 on the Elko conversion of a Plymouth Horizon to a 67-mpg diesel. Here's how a converted VW diesel performs.

"Now try it for top speed," said Klaus Elsbett as I wheeled onto the Autobahn near Nuremberg, West Germany. With the accelerator floored, I watched the speedometer climb—80, 90, 100, 110, 115 mph. I've driven faster, but this was no 12-cylinder Ferrari. It was a modified VW Rabbit with a tiny three-cylinder turbocharged diesel engine.

The Elko (for Elsbett Konstruktion) engine is a little miracle. Its power and economy are due to Dr. Ludwig Elsbett's patented combustion system. The key is the swirl given to surplus air during combustion, which prevents the flame front from contacting the piston metal. This in turn prevents heat loss to the special low-conductivity, cast-iron pistons, which contain an open-top spherical cavity that serves as the combustion chamber. With less heat lost this way, more of the fuel's caloric value is turned into useful power.

The engine does not have a cooling radiator; it's not air-cooled, either. Cylinders are surrounded by oil-filled jackets, and the cylinder head has oil channels drilled around the exhaust valves. The cooling oil is part of the engine-lube system. Oil circulation to the standard VW heater core provides adequate heat-exchange capacity.

At 4,000 to 4,500 rpm, the engine puts out 70 hp. It has a five-speed VW transmission geared for a road speed of 25 mph per 1,000 rpm in top gear (overdrive).

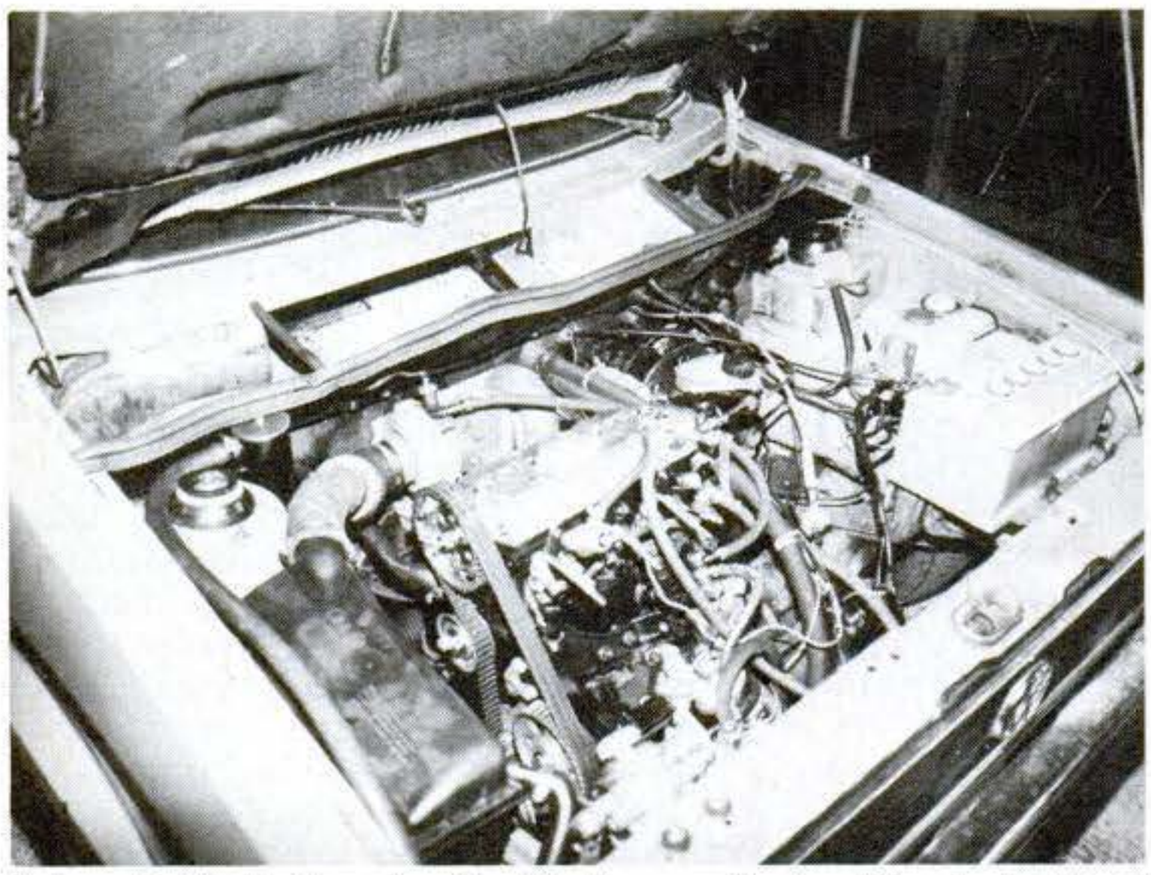
The converted Rabbit accelerated from zero to 60 mph in 14.5 seconds. Klaus Elsbett, the inventor's son who handles the firm's business, showed me a list of fuel-consumption figures: 71.2 mpg at 56 mph, 40.5 mpg at 74.5 mph, 37.3 mpg at 87 mph, and 27.6 mpg at 100 mph. That's 37 percent better than the VW Rabbit Diesel at 56 mph and 21 percent better at 75 mph. "You can drive faster when you have a more economical engine," grinned Dr. Elsbett. He wasn't joking.

On the car I drove, Elsbett had fitted a small Bosch in-line injection pump with standard truck-type injector nozzles. These inject a single jet tangential to the chamber wall into the swirling air. Fuel mixes only with the central portion of the air.

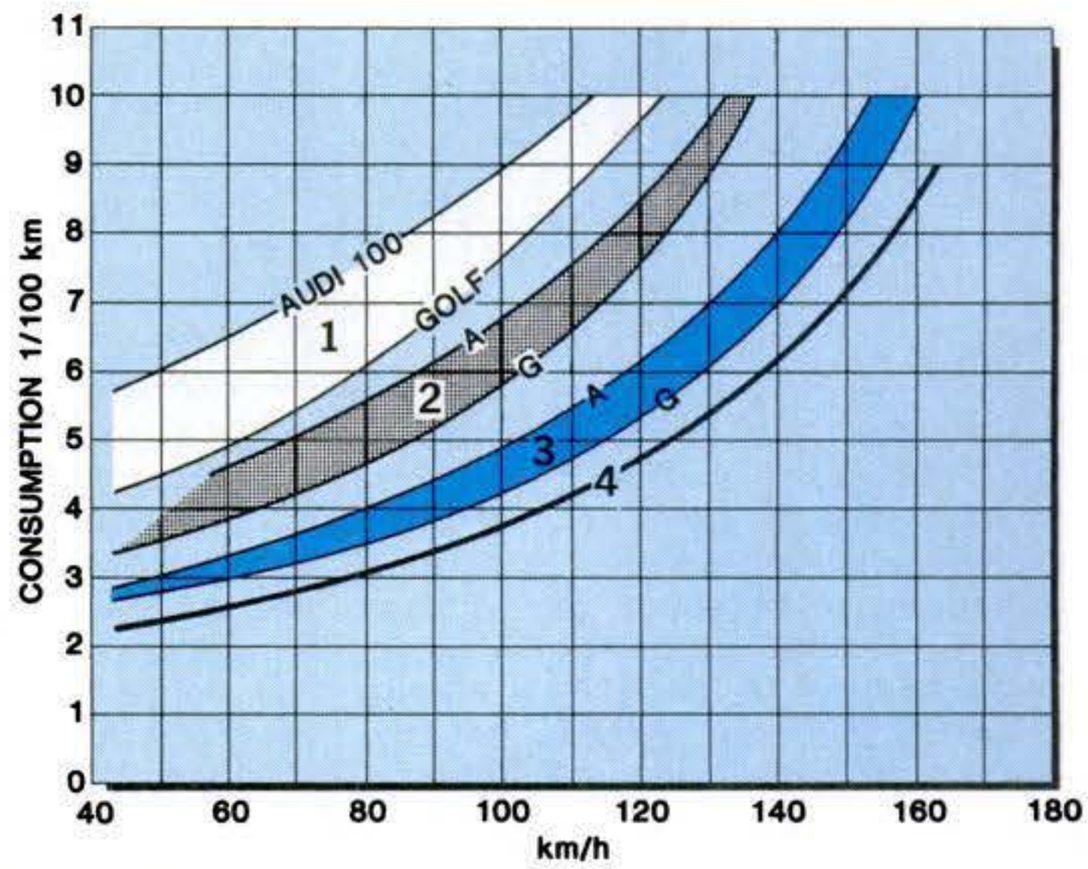
Inside the lab I saw another Rabbit with newer pumpless fuel injection. "We call it integrated injection," Dr. Elsbett said. Components removed from the pump were combined with individual injectors. "That takes a lot of the cost out of our diesel," he said. "The integrated injection for a three-cylinder unit is no more expensive than a modern carburetor."

The Elko engine is based on the VW four cylinder. It has a different crankshaft, dictated when one cylinder is chopped off. Total displacement is only 85 cubic inches. "Compared with the four-cylinder VW engine," says Dr. Elsbett, "the Elko runs with reduced friction, lower reciprocating masses, and costs less to build. With the savings from the fourth cylinder, we can pay for the turbocharger." The KKK turbocharger allows the engine to work with undiminished efficiency even at high speeds.

Will a car company offer the Elko? That depends on matching Elko principles to existing engines or to new designs in needed sizes. BMW's Dr. Karlheinz Radermacher says the company hasn't been able to duplicate the fuel-consumption results claimed by Elsbett. But several other major firms seem impressed with the progress they see. PS



Integrated injectors for fuel in three-cylinder Elko turbodiesel operate without an injection pump. The combustion process remains the same but at far lower cost. Pump plunger and spill-port elements are used with these injectors.



Improved heat insulation in its modified engine boosts fuel economy, say the developers. Plots 1, 2, and 3 show consumption for Audi 100 and VW Golf cars with a gas engine, swirl chamber, and Elsbett injector, respectively; 4 is firm's development vehicle.

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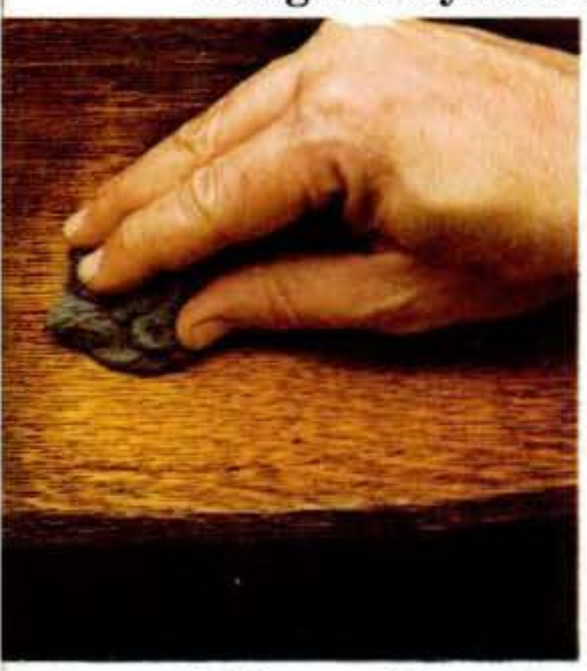

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Popular Science

PS | What's News

Since the beginning of the Industrial Revolution, engines have been made of metal. That's about to change. A whole new generation of ceramic engines is about to come on the scene.

Why make an engine out of a material associated until now mostly with baking dishes and decorative figurines? The reason isn't hard to find. The emphasis these days is on designing cars to get more miles from a gallon of gas. The equations that explain how an engine operates say clearly that the higher the temperature at which an engine can run, the more efficient will be its operation. But engines made out of metal have about reached the upper limits. The solution: Go to something that can get hotter and still operate.

That's where ceramics come in. They can take intense heat. That's why they're used for rocket nose cones and to protect the Space Shuttle during reentry. But until recently, they've been too fragile and brittle for engine use. Now, new work is producing ceramics that show promise in this application. Today in the labs they're being used to line cylinders, piston heads, valves, and exhaust manifolds. The cover painting shows such an engine. One day soon, cylinder heads and perhaps even engine blocks will be cast of ceramics. In other laboratories, ceramic abrasive blades that can take extreme heat are under test and may soon make the gas turbine practical. As these developments progress, a new age of high-temperature, high-efficiency engines will dawn. John Free's article outlines what's happening now in the research laboratory and what we can expect to see in the future. The cover painting is by Dean Ellis.

HTGR goes to work

High temperatures improve efficiency in all thermodynamic processes, not just engines. That's the basic fact behind the design of the High Temperature Gas-Cooled Reactor [PS, Feb. '75] that just made its first full-power run in Colorado. Instead of using water as a coolant and heat-transfer medium, the HTGR uses a gas—helium. The tests confirmed the design goals. The helium coolant left the reactor at 1,400 degrees F, and produced 995-degree steam at 2,430 psi to drive the plant's 330,000-kW turbine generator. Most important, the test indicated that the plant achieves an operating efficiency of more than 38.5 percent—20 percent better than water-cooled plants.

A sobering alcohol experiment

Six years ago, the Brazilian government launched a program designed to produce one billion gallons of alcohol a year and convert many of the cars on the road to use alcohol. The scheme was designed to free Brazil from dependence on foreign oil. But problems have developed. Alcohol-car owners complain about slow starting and stalling, and say that carburetors and fuel lines corrode and are expensive to repair. They also say they get poor fuel mileage.

In addition, alcohol prices—while still lower than gas prices—are going up faster than gasoline prices. Gasoline has shot to $2.70 a gallon, while alcohol is up to $1.65. For all of these reasons, half of the cars produced to run on alcohol remain unsold this year. And mechanics licensed to convert older cars from gas to alcohol report that they are instead converting the new alcohol cars to run on gasoline. The government, though, has not lost faith. Plans have been announced to increase production goals by a factor of three—to three billion gallons a year by 1986. And the pressure to get people to drive alcohol cars will continue.

Geothermal cool-down

California utilities have been making electricity from geothermal steam for 20 years at the highly publicized Geysers field northeast of San Francisco [PS, Aug. '72]. But a far more abundant source of geothermal energy—the huge reserves of hot water that lie beneath the Imperial Valley and elsewhere—has been much more difficult to tap. Despite various operating experimental generators, development has been slow and technical difficulties, such as scaling of the equipment, formidable. And that, naturally, has made costs rise sharply.

A few years ago, geologists forecast that geothermal might produce five percent of the country's energy needs by 1985, and at a cost comparable with $32-per-barrel oil. Now they're scaling down estimates of the total amount that will be produced, and saying the costs will rise to an oil-equivalent price of $40 a barrel. Further, as federal energy-development funds are slashed, the picture continues to darken. Said Donald R. Pitts, professor of engineering at Clemson University and a geothermal expert, "I'm not optimistic. We're not much further along than we were in 1973."

Around the world on a fill

Two companies are building planes designed to fly around the world nonstop with only the fuel on board at takeoff. Both operations are headquartered at Mojave Airport, 100 miles north of Los Angeles.

One contender is Quickie Aircraft [PS, Aug. '81], which has developed a single-place, single-engine craft now involved in flight testing. It's made of low-density foam sandwiched between layers of glass fiber, cloth, and resin. The 52-foot wing is thin and highly efficient. The plane will try to make the globe-circling flight with 360 gallons of gas, but capacity can be increased to 550 gallons if necessary. Pilot for the attempt will be J. Thomas Jewett, president of Quickie Aircraft. He plans to fly from California across the United States, on across the Atlantic to the Mediterranean, then across Egypt, India, China, and the Pacific for an estimated 23,000-mile flight. He foresees a speed of about 200 miles per hour—so the trip will take something over four days. He plans to sleep about 10 hours during the entire period while an autopilot takes over.

The other plane is being designed by Burt Rutan, known for such high-efficiency craft as the VariEze [PS, Nov. '78]. This is a far more unconventional plane, constructed of a graphite-impregnated glass-fiber material. The two-place plane will have a 100-foot wingspan, a pusher/puller twin engine and propeller arrangement, and have outrigger fuel tanks to join the main wing and the forward canard. It will carry 1,400 gallons of fuel, weigh 10,000 pounds, and have a range of 28,000 miles. It will not be ready for flight until sometime later in the year.

Editor-in-Chief

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The coming age of ceramic engines

A family of heat-resistant, super-tough ceramics can deliver big fuel savings

By JOHN FREE

"If you convert a car's fuel into energy, about one-third of it goes into output-shaft power, one-third goes into the coolant, and one-third goes into the exhaust," says Arthur McClean, manager of ceramic materials at Ford's scientific-research laboratory near Detroit.

Such appalling waste of fuel energy began in the late 19th century when Germany's Nikolaus Otto and Rudolf Diesel developed the two types of piston engines used almost exclusively in today's vehicles.

These internal-combustion engines require power-robbing cooling systems so metal parts aren't damaged. Heat energy in the exhaust is dissipated instead of being put to work. And the white-hot, metal-melting temperatures needed for higher efficiency conversion of fuels just aren't practical.

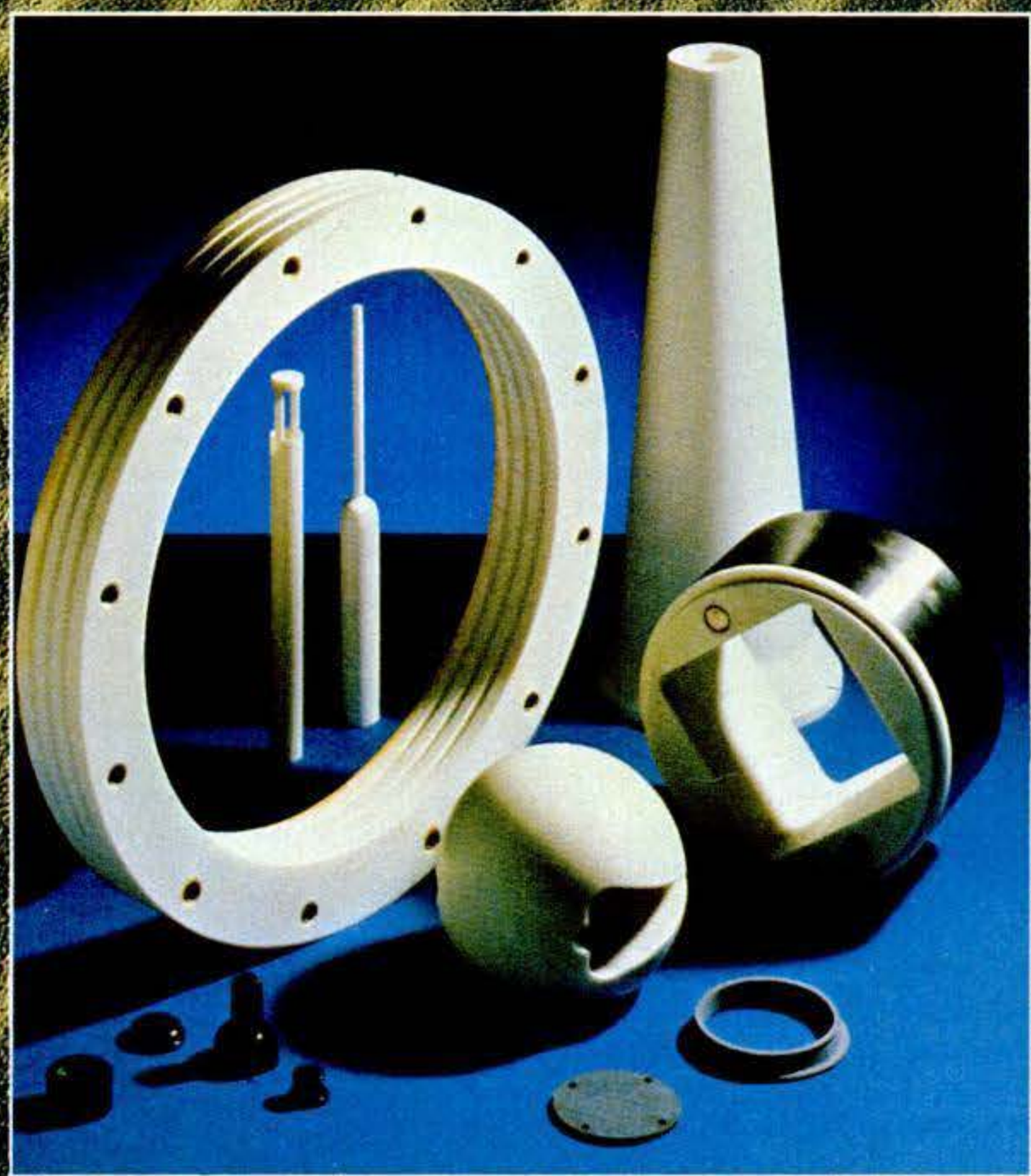
But in Ford's Dearborn, Mich., labs and other research centers I've visited, experimental ceramic engine components are being developed to significantly cut fuel-energy waste. A new family of remarkable super-ceramics has emerged in the past decade. What makes ceramics technology so attractive is that, fully exploited, it can save an estimated 500 million barrels of oil annually. But like metal alloys, a ceramic material often has properties that make it suitable for one task in an engine but not another.

Engineers plan to exploit special properties of ceramics—super strength at high temperatures, resistance to thermal shock, superb heat insulation, lower density than metals, wear and corrosion resistance—in several ways:

Gas-turbine engines. The extremely high temperatures possible in ceramic-based turbines, plus recovery of exhaust-gas heat, promise exceptional fuel efficiency. Engineers predict lower emissions than ordinary engines achieve. Moreover, turbines can burn alternative fuels. Big turbines for utility power plants will enjoy similar benefits.

Uncooled engines. So-called adiabatic (no heat loss) diesels are a long-

[*Continued*]



Spectacular abundance of silicon in sand and in many minerals makes it a cheap, unlimited resource, combined with other materials, for ceramics. New technologies are creating ceramics to replace metals.

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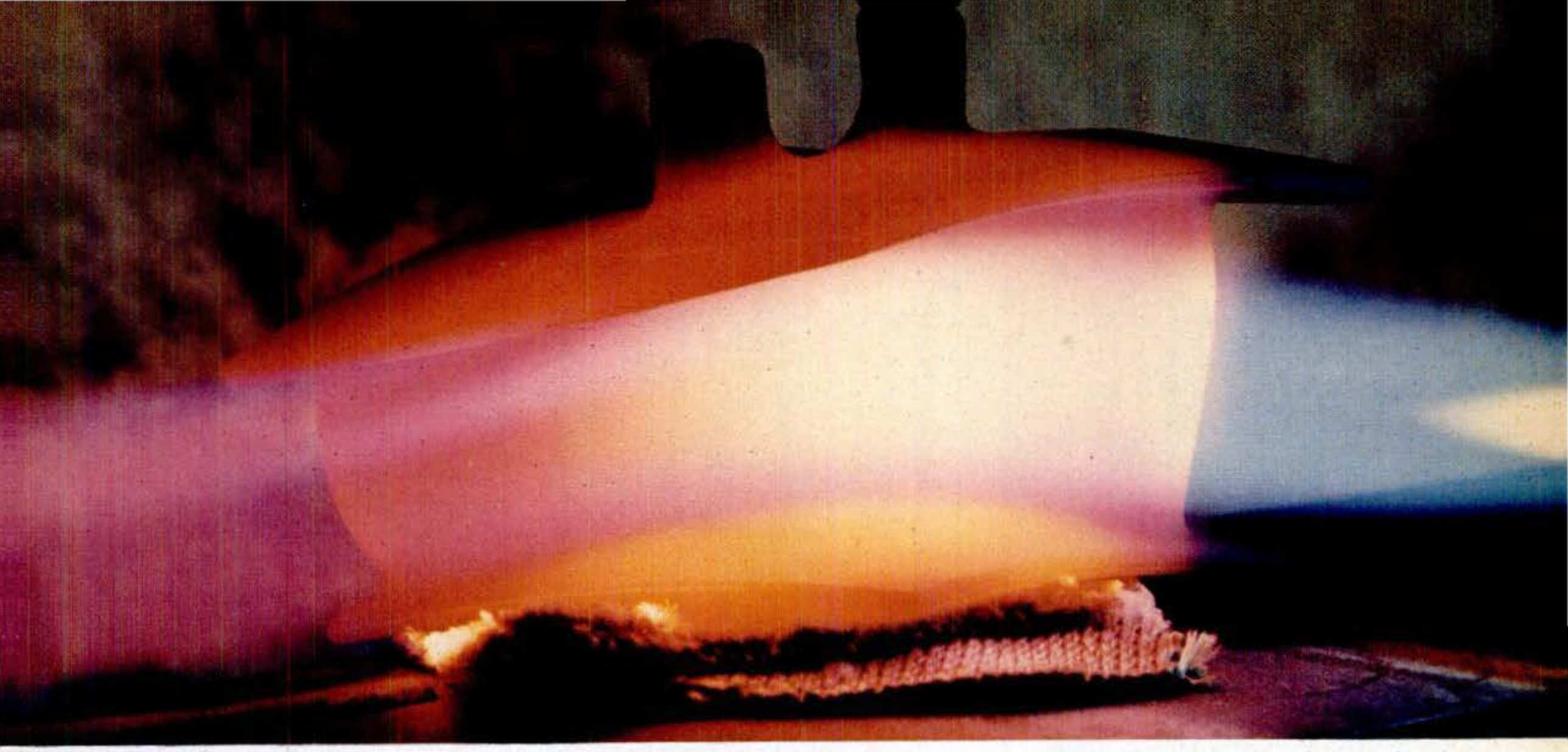
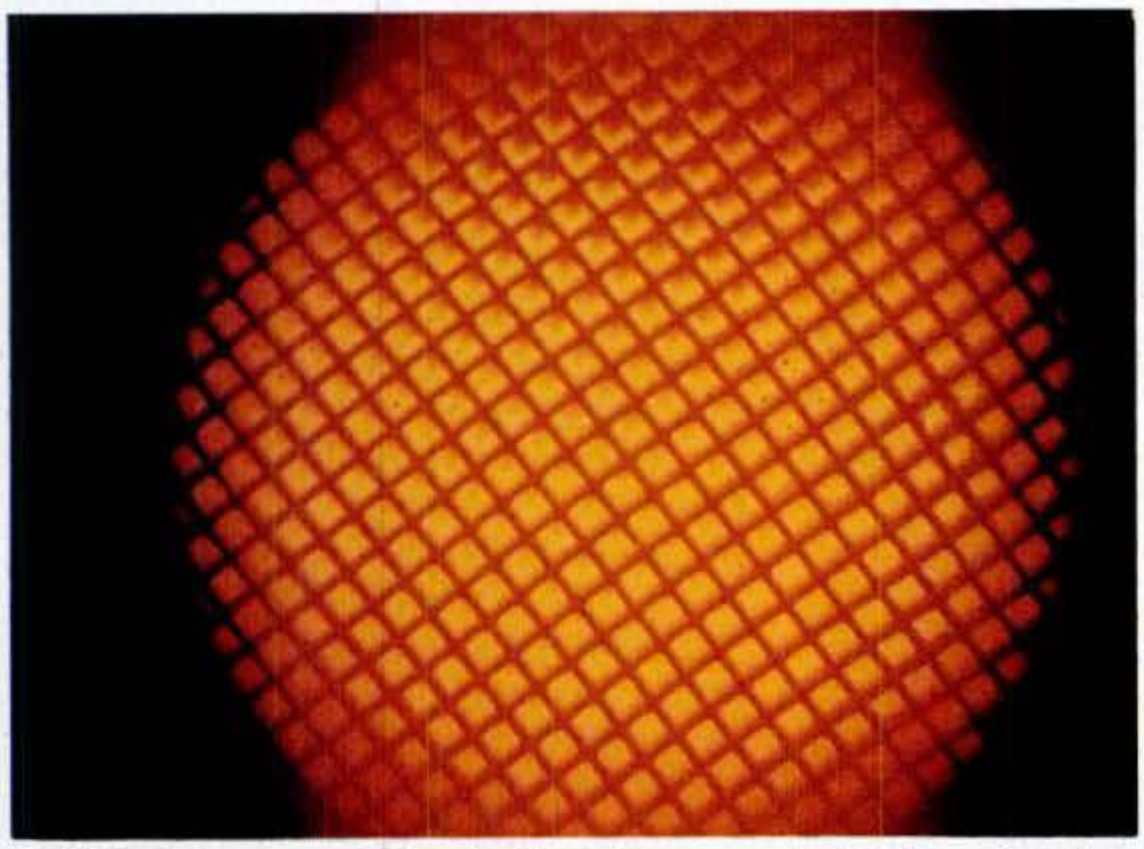
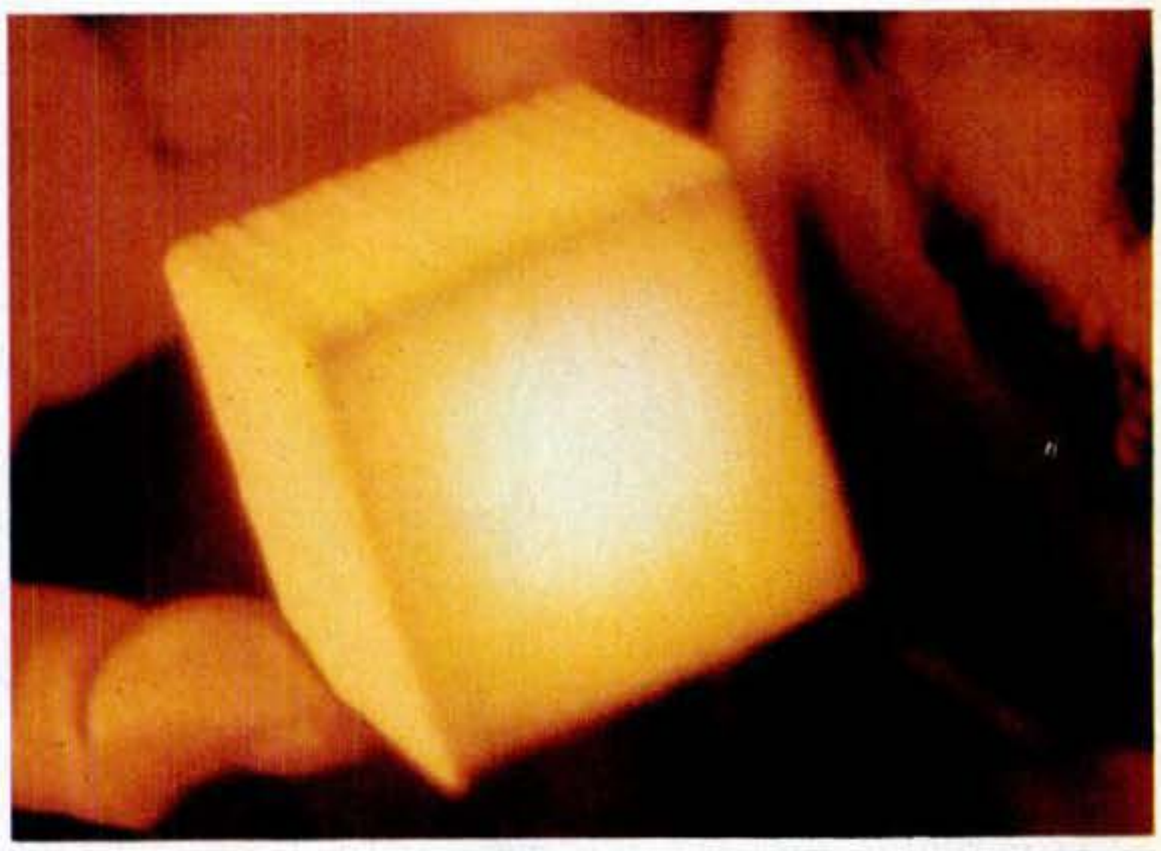


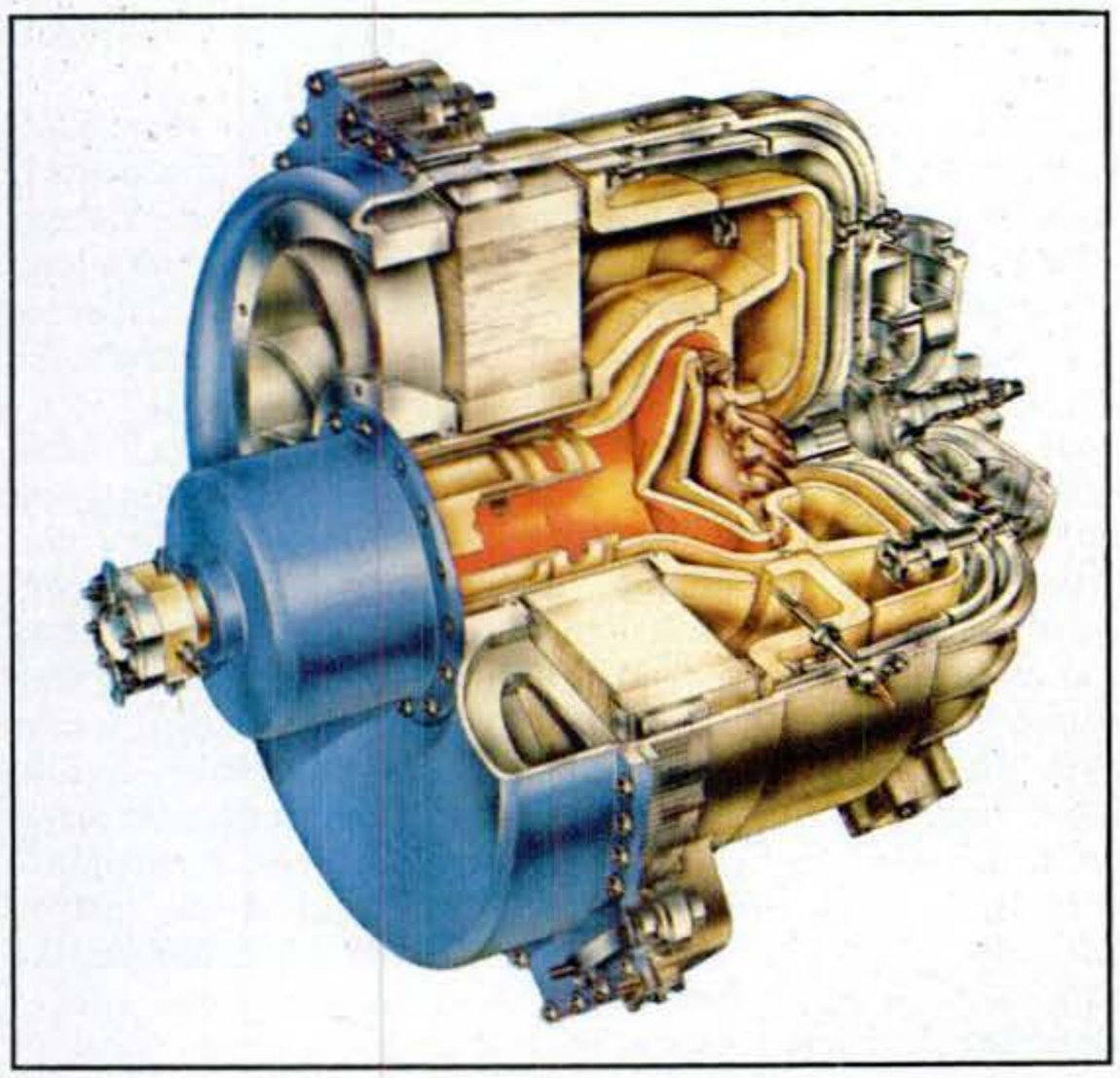
Thermal shock test on a silicon nitride turbine vane for Garrett Turbine Engine Co. heats vane white-hot, then air-quenches it.



Cellular structure of Corning's Celcor ceramic has broad surface area for diesel filters, stove and car catalytic combustors.



Glowing ceramic tile dissipates surface heat so quickly that it can be held barehanded while its interior still glows with heat.



Advanced gas turbine for cars, the Garrett-Ford AGT101, will have ceramic parts (tan color) to boost engine efficiency.

Silicon carbide turbine blades made by General Electric shrink to final size (right) after they're removed from mold and sintered.

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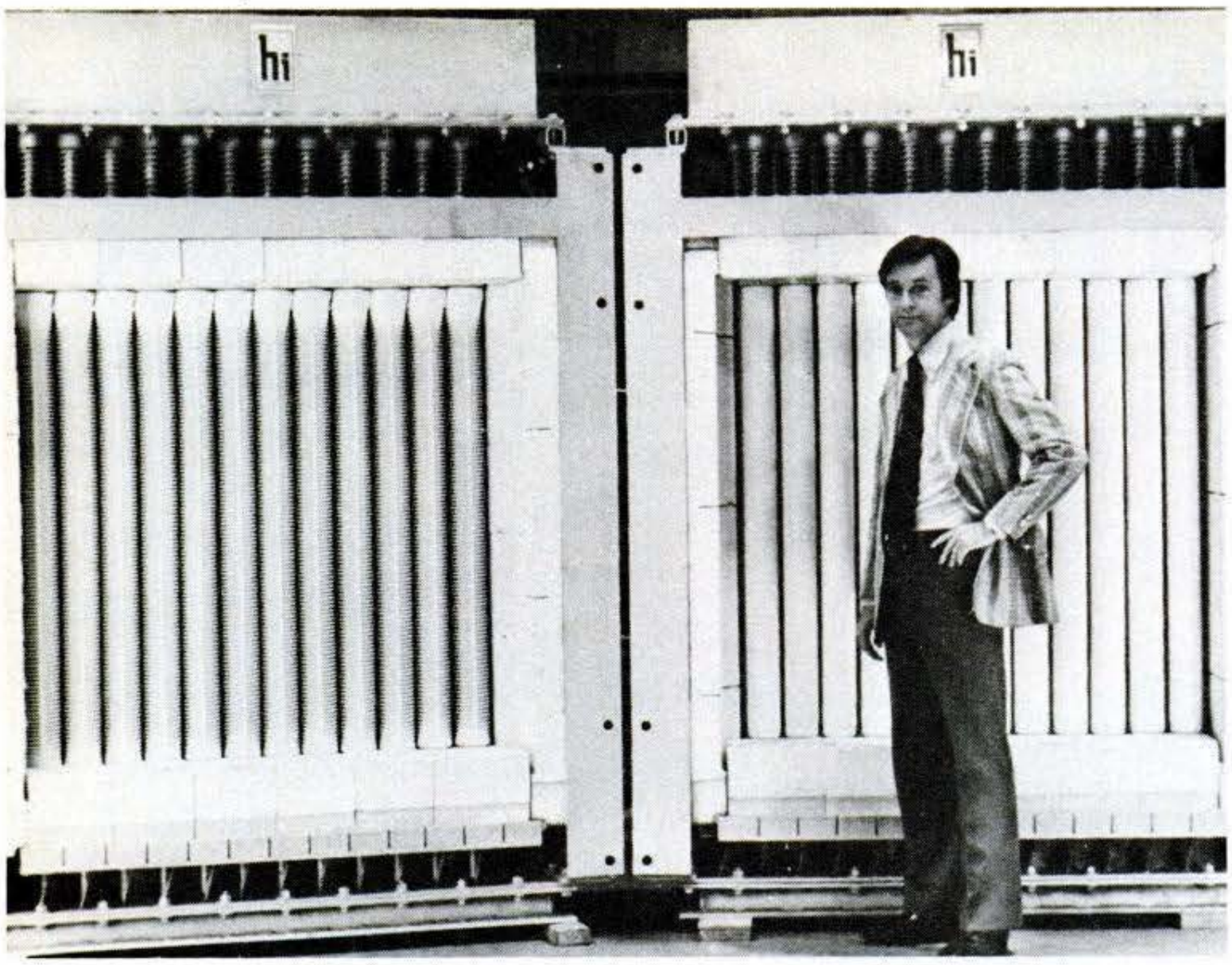
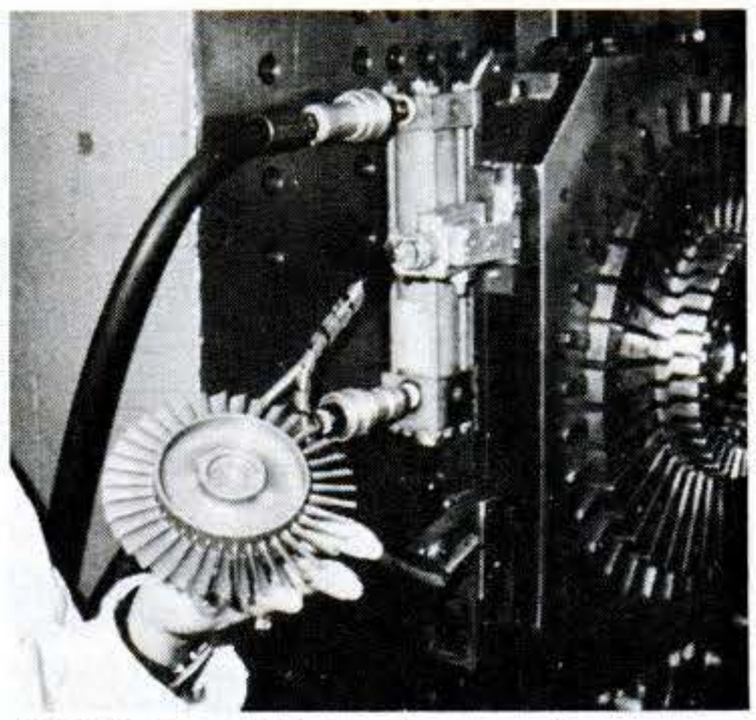


High-temperature ceramic heat exchangers from Hague International (Portland, Maine) recover energy lost from blast furnaces to preheat combustion air.

Computer-aided design has key role with ceramics: engineering component shapes to avoid overstressing the brittle material. Terminal displays a Ford part.



Injection molding of ceramic components, as for plastics, promises mass production of such engine parts as this Ford turbine. Sintering is the final step.

term (1990's) goal. [See cover painting.] Exhaust heat from a waterless, ceramic-component diesel can be tapped by turbines. High thermal efficiency, reduced emissions and noise, and multi-fuel capability are benefits.

Heat exchangers. Ceramic recuperators can tap heat energy normally wasted by furnaces used in metal, glass, and other industries. Energy from these "heat engines" can preheat combustion air to boost efficiency or be used in other industrial processes.

Efforts to develop ceramics for high-temperature applications accelerated in the 1970's. The Arab oil boycott and steep fuel prices sent governments and companies scrambling for ways to boost engine efficiencies.

Federally funded research programs have given the U.S. a big lead in ceramics. But just as new programs are getting under way overseas—benefiting from U.S. advances—researchers here are worried that government cutbacks will cripple our lead.

The latest research involves minimizing a serious fault of ceramic material for structural design: its brittleness. Metal under stress bends. Overstress a ceramic part, and it flies apart. Researchers have tested all of the ceramic components needed for piston or turbine engines. They work. For vehicles, however, these parts must have exceptional reliability. To reduce the risk of fracture, ceramists are learning how to manipulate crystal structures and add tiny fibers to create composite ceramics.

Other challenges facing vehicle manufacturers before ceramic engines become practical:

- Perfecting reliable methods of physically linking ceramic and metal engine parts.
- Creating non-destructive testing methods for components.
- Establishing production sources for purified raw materials.

The raw materials for structural ceramics are incredibly abundant. One of the most common materials is silicon, about 28 percent of the earth's crust by weight. It's found in sand and other silicates. Nitrogen, another super-ceramic ingredient, is 78 percent of the atmosphere (by volume). Carbon, also used, is plentiful, too. By contrast, iron needed for steel makes up only five percent of the earth's crust.

Ceramic cheeses

One ceramics manufacturer, Corning Glass Works (Corning, N.Y.), has already established mass-production economies for a ceramic component in most cars today: the honeycomb-like substrate in catalytic converters that clean up engine exhaust.

That technology—extruding ceramic material from dies and cutting it into chunks—may serve future gas-turbine production. (Corning just shipped an experimental turbine-engine part made with this technique to General Motors.) But when I toured Corning's facilities, these turbine-engine regenerator discs were being made in a different way—starting with ordinary tea-bag paper.

Reaching into a barrel, I scooped up a handful of what looked like glass chips. It appeared someone had fed plates and cups through a garbage disposal. In fact, this was lithium alumina silicate (LAS), the same raw material, in semi-processed form, that Corning uses for its mass-marketed Corning Ware.

To make a regenerator disc, LAS chips are pulverized to a fine powder in a ball mill, mixed with proprietary liquid plastics, and used to coat a long roll of tea-bag paper. The paper is crimped like corrugated cardboard and spooled into a roll.

The resulting discs are then fired in ovens, which burns out the plastic and paper. In this final step, called sintering, common to most ceramics processes, discs are heated at high temperatures for an extended period. Physical and chemical processes occur as tiny particles fuse together, shrinking the discs to predetermined sizes. The glass material is transformed into a ceramic. The final discs, sitting about a huge factory room, looked like giant white cheeses several inches thick, with diameters from about 14 inches up to six feet.

[Continued on page 130]

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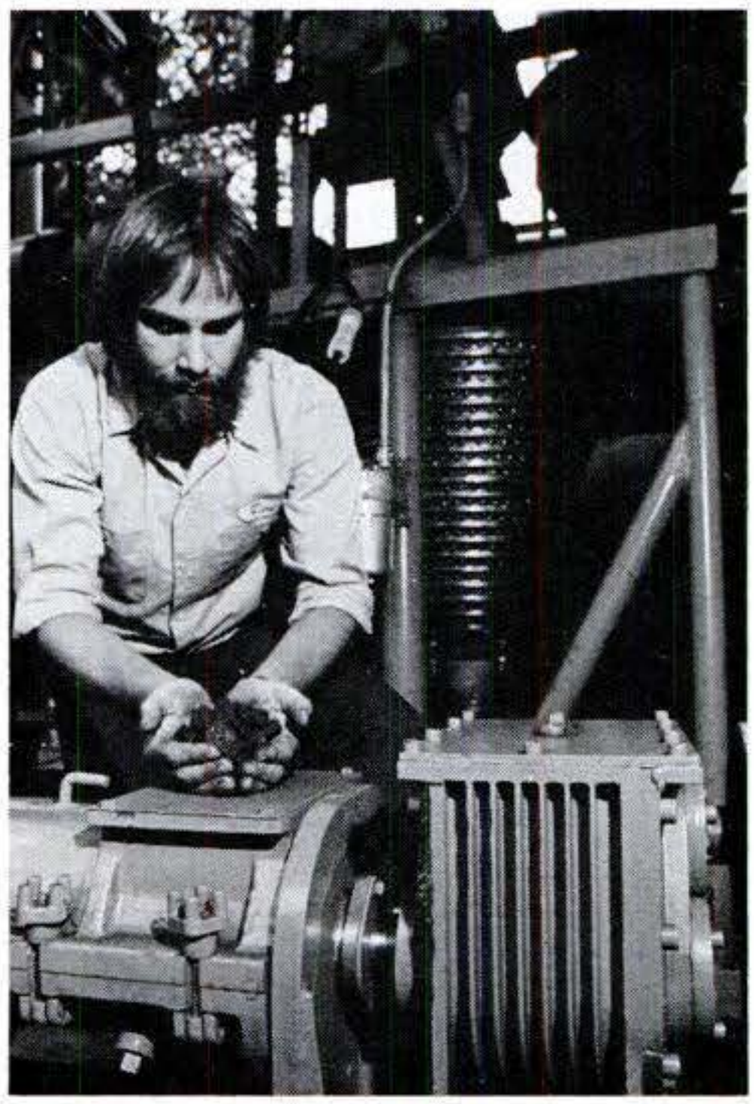
Low-cost route to a new liquid fuel: coal slurry



Coal-water slurry has about the same viscosity as SAE 50 motor oil (left). Technician at experimental plant (right) puts coal on a screen that's used for rough sizing of the particles. Water and additives are blended, then added to the cone-shaped mixer. The crushed coal is introduced while the mixer operates.

Pulverized coal plus H_2O could replace residual oil

By JAMES R. HARDCASTLE

In Alexandria, Va., about eight miles south of Washington, D.C., a small team of researchers at the Atlantic Research Corp., an aerospace firm, may have come up with an answer to one part of America's energy dilemma. Their development could help to turn our abundant coal into a liquid fuel that could replace some imported oil—and do so economically.

The usual method of converting coal into a liquid fuel is to rearrange its molecular structure, an extraordinarily complex and expensive task. Instead, the Atlantic Research team is mechanically pulverizing the coal into a fine powder and mixing it with water to form a slurry.

The slurry has thermodynamic properties similar to residual oil, a thick fuel oil used by electric utilities and large industrial users, according to Charles T. Henderson, senior vice-president of Atlantic Research. If it could replace residual fuel oil, the impact would be significant. Residual oil accounts for about 13 percent of our petroleum imports.

Unlike solid coal, the coal slurry could be transported, handled, stored, and fired just as conveniently as oil. And, says Henderson, "in combustion tests in the company's 1.3 million-Btu-per-hour furnace, it has burned with an extremely stable flame."

The success of the slurry is due to a careful blending of coal particles ground to two different sizes: The larger size provides maximum coal loading, the smaller fills in the gaps and stabilizes the mix. By including a small amount of additives, the researchers have produced slurries containing up to 75 percent coal.

Coal slurry could potentially provide energy at a fraction of the cost of oil, Henderson believes. "While residual oil now sells for $5 per million Btu, coal sells for only $1.50 per million," he explains. To this must be added the cost of building and operating the slurry plant, but it would be fairly simple, built with off-the-shelf hardware. "Our best estimate is that after counting all costs including profit, we should be able to produce coal-water slurries for about half the cost of residual oil," Henderson says.

About 55 percent of the company's work has been supported by the U.S. Department of Energy and the Electric Power Research Institute (EPRI). Other firms, most notably Gulf & Western, Sweden's Carbogel Ab, and Slurrytech, Inc., have launched coal-slurry programs, also. Atlantic Research is expanding its pilot line from a one-barrel-per-hour capacity to 25 barrels an hour. And EPRI is scouting for a utility to field-test the slurry.

The biggest concern of potential users is a probable loss in heat output from their boilers, and hence a loss in generating capacity. This loss, called derating, will almost certainly occur, because slurries contain much more mineral matter—ash—than does oil. This ash produces soot, which reduces a boiler's heat output by covering heat-transfer surfaces with slag. Ash can also erode the innards of boilers not specifically designed for coal.

Most experts have little doubt that coal-water mixtures can be used successfully in boilers designed for coal burning but later switched to oil, as many were in the 1960's and early '70's. Today it would be almost impossible to switch them back to solid coal because their coal-handling equipment has been dismantled. Converting them to slurries, however, should be relatively simple. Since they were designed to use higher-ash fuel, they shouldn't suffer much derating.

Converting boilers designed solely for oil, however, could mean a much greater loss of output. But even with that, utilities may find the derating more acceptable than the increasing price of oil.

By 1985, EPRI and Atlantic Research managers agree, coal slurry should be a widely accepted fuel option, and commercial equipment should be available to prepare, transport, handle, and burn it.

In the energy business, where it takes 10 years to build a power plant and nearly as long to open a mine, such a short lead time is unheard of. At last it seems we may have an energy alternative for the short term. PS

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Dome home
from silo parts

Super-insulated twin-wall domes merge like soap bubbles to make a home

By EVERETT H. ORTNER
PHOTOS BY KRISTEN PETERSON

"Super-insulated dome clusters," their designer, Michael E. Jantzen, calls them. He makes them from the steel igloos that form the roofs of silos in farming country. Jantzen punches holes in them for doors and windows, stuffs them with insulation, and designs handsome furniture for them that suits their special conformation. He and his wife, Ellen, built their first house of silo components in 1974. Later, with Ted Bakewell, he built the Autonomous Dwelling featured in POPULAR SCIENCE [April '80]. Now he's done it again, with a new prototype dome-housing system.

His goal: to build a modular house that could respond perfectly to the needs of its owner—even grow and shrink in size. "You could start off cheaply, add space as your family grew, then shrink the house when the kids were gone—even give the kids a dome to grow their own house."

Jantzen has been working with the

[Continued on page 128]

DOME CLUSTER consists of four hemispheric silo-roof units made up of two-piece (upper and lower) galvanized-steel strips, called sheets. These are two feet wide at bottom, and bolt together at bottom, center, and top. Domes come in different sizes, up to 32 ft. diameter; Jantzen used 26-footers for outer shells. He started with center dome (top photo, with entrance), assembling sheets clockwise. After making cutouts where the dome would join other domes, he started assembling others, making cutouts in those, too, as he came to matching points. Domes were then joined with an arch assembly designed by Jantzen. Inside the 26-ft. shells he now began to install 24-ft. inner domes. As sheets came in two pieces, he could put in all lower pieces first, making cutouts to match existing ones. Then he put in cellulose insulation, let it settle for a week, and added more before bolting on upper sheets and blowing in the rest of the cellulose. With 16 inches of cellulose at top, 12 inches elsewhere, he got an R-value of 46. To create a secure vapor barrier, Jantzen taped all seams between sheets with aluminum tape. Bridging between shells is gasketed so that no heat is lost through conduction. Wiring and plumbing (polybutylene) are run between the walls of the shells.

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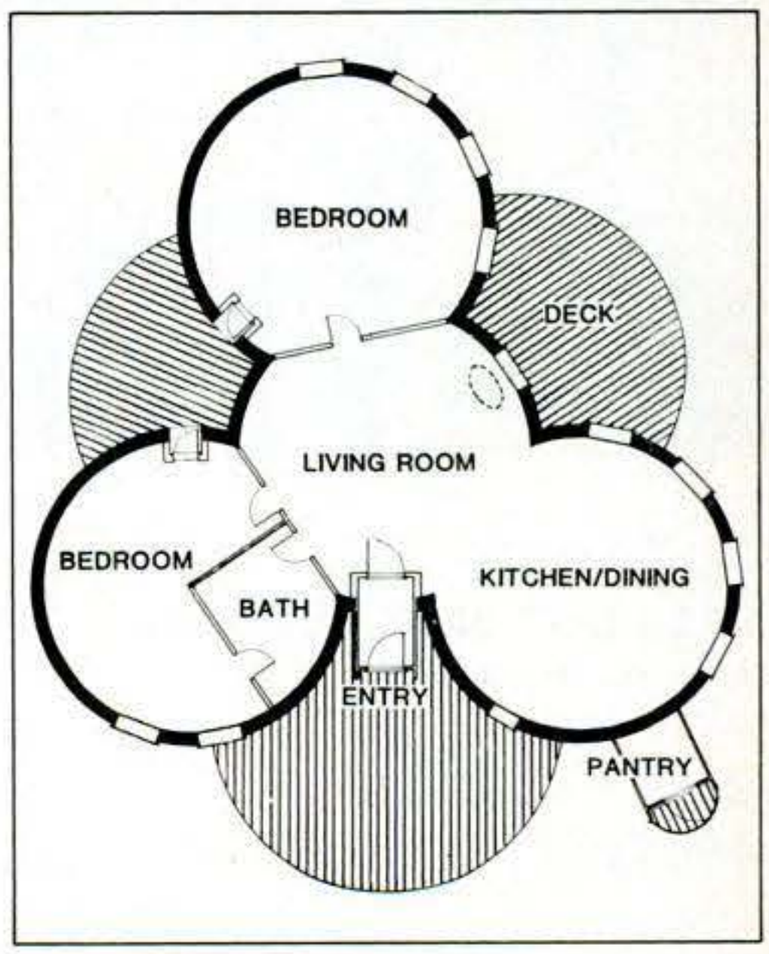

DOME INTERIOR comes prepainted, but Jantzen added a ½- to ¾-inch-thick spray-on cellulose coating as an acoustical barrier and painted over that. Windows ended up circular because dome maker had a frame that could be adapted. Glass is double-pane, sealed in car-type gasket. Louvers over windows are opened and closed by string from outside; besides blocking sun, they supply privacy. Arrays of windows (lower photo, facing page) in bedroom and kitchen face generally south. Ventilation in tight house is dealt with by roof vents that exhaust air, and by small openings around house, supplemented by door vents, to admit air. In summer, a heat exchanger in a well under front deck can be used for cooling. Domes are set directly on concrete slab so earth heat helps to stabilize temperature. Toilet is a Swedish low-flush unit; appliances are high-efficiency types. A built-in dryer over refrigerator uses waste heat to dry fruit; waste heat from oven supplies food warmer. Furniture is all designed and built by Jantzen (with wife Ellen and brother Eric). Top inset photo shows part of bedroom; center photo is living room; bottom is kitchen. Entry structure (top photo, facing page) is double-door airlock made of "chute" sections—which are normally used on the side of a silo.

BUILDING A DOME HOME: Jantzen emphasizes that his dome house is a prototype, still being closely monitored. At press time, it was facing its first winter with five loving (but severe) critics in residence: Jantzen's mother and four sisters. For a manufacturers' list and information about the project and its design philosophy and development, send $3 to Michael E. Jantzen, Box 217, Carlyle, Ill. 62231. For information about structural aspects, send a stamped, self-addressed envelope to Railoc Co., Inc., 1300 No. Division St., Box 218, Plainfield, Ill. 60544. For a set of blueprints, send $75 to Railoc.

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Inflatable pedal plane

No hangar? This man-powered airplane stores in a closet

By BEN KOCIVAR
PHOTOS BY NICK BRAWNE

Man-powered flight was proved feasible by the Gossamer Condor's figure-8 flight in 1977 and the Gossamer Albatross's Channel crossing two years later [PS, Jan. and Dec. '78]. Inflatable airplanes were proved flyable by, among other craft, Goodyear's Inflatoplane, which was tested extensively by the Navy in the late 1950's.

Man-powered flight in an inflatable craft has not yet been proved possible, but Fred To has no doubts that his Phoenix airplane will fulfill that dream as soon as spring brings calm weather to his test grounds in Chiswick, England.

The pictures here were taken last August during the first of three successful towed flights in which the 102-ft.-wingspan craft went airborne under the power of a single running man pulling a nylon rope. "A pedal-power takeoff failed when a joint in the chain transmission let us down," To said.

PS readers might remember To as the ingenious engineer from London who built and flew the photovoltaic-powered aircraft Solar One [PS, July '80]. With his new plane, To hopes to claim three remaining Kremer Prizes for man-powered flight by citizens of the United Kingdom.

Fred To is not the first to build an inflatable pedal plane. His work is based on that of an earlier aeronautical pioneer, Dan Perkins, who built four such craft from polyurethane-coated nylon before he died in 1975. "Dan recognized the two great advantages of inflatables for man-powered craft," To told me. "They can be packed into a small space for storage and transport. And they simply bounce when they hit something."

The Phoenix proved his point. During one of its tow tests last summer, the craft lost control and crashed from a height of 25 feet. "To my delight, it bounced—just as Dan said it would," To recalled.

For transport, the 105-lb. craft can be folded and carried on a car top. All of the components are lightweight: The pilot-support frame is Kevlar; the skin is polyester film bonded with Bostik adhesive; the 18-ft. propeller has balsa ribs covered with Solarfilm heat-shrink plastic.

The most intriguing feature of the design is that flight control by the ped-

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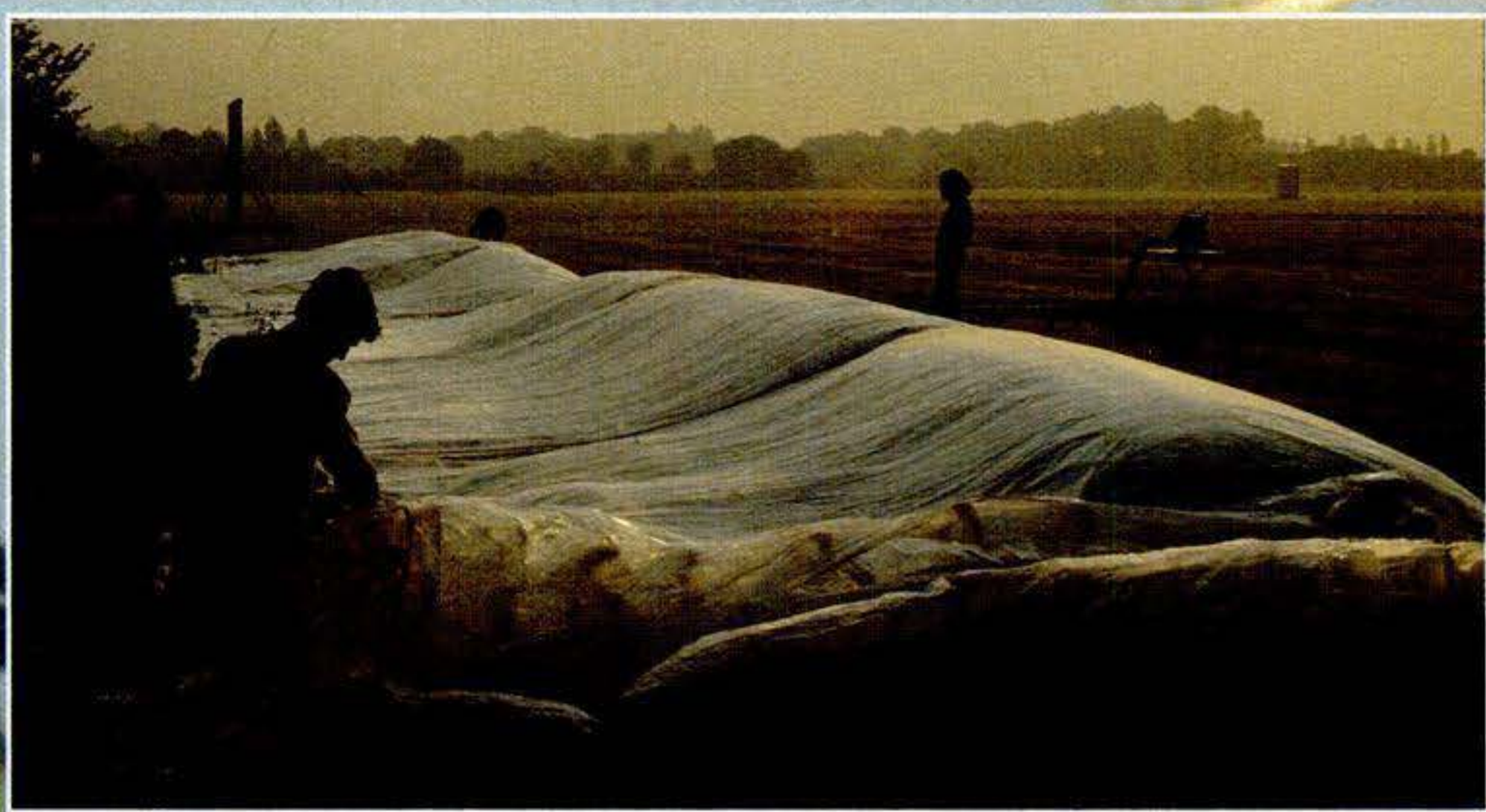

aler is not necessary. The 11 electric model-airplane servos that operate the elevator, ailerons, and rudders can be remote-controlled with a transmitter by a "pilot" on the ground.

"This makes pilot selection easier," To said. "A future owner could let his muscular friends have a go at pedaling while he takes care of piloting from the ground."

The Phoenix is designed to fly at eight mph with only ⅓ horsepower. If it proves successful, To's next goal is a hybrid-powered version he hopes to market. The 60-lb., 50-ft.-wingspan plane would cruise at about 15 mph under combined power from the pilot's legs and a model-airplane engine. "The idea," To said, "is to fix the power requirement so that it is difficult to take off by either engine or man power alone, but quite easy with both working together." PS

Phoenix has risen only under tow so far, but transmission tests proved that prop (detached here) performed as designed at 45 rpm. Pump inflates craft to 0.4 psi in 15 minutes (top). Turned-down winglets (center) act as rudders, reduce induced drag. Bottom: Designer To makes last preparations for towed flight.

Across a room (or continent) you're in command with **remote-control gadgets**

Appliances snap to life —even your bath is drawn— and all from your easy chair

By MYRON BERGER
DRAWING BY ROY DOTY

Ma Bell may have the right idea with: "Let your fingers do the walking." Thanks to new electronic technology, remote-control systems for home appliances let your digits stroll over a key-pad transmitter while your tootsies take it easy.

Push a button, and ultrasonic waves or infrared light carry your bidding to waiting slaves. Lights gleam, appliances perform, the phone is dialed, your bath is drawn—and all from a wireless control center nestled conveniently in the palm of your hand.

Remote controls seem to be the newest electronic fad for just about everything—and everybody. Especially me. I'm a glutton for gadgetry, so I couldn't resist gathering and trying a bunch of them in my home. I learned they're a real convenience. But I also found out they can be true nuisances as well. Here's why:

Left hip for lamps

Take my living room. I have separate remote controls for my hi-fi system, television set, video-disc player, video-cassette recorder and several lamps. Sure, it may be great to lean back in the couch and enjoy not having to get up to turn the volume down, but heaven forbid I should want to be mobile and in control at the same time. Actually, I have found a solution to this dilemma.

A while ago I bought a military web belt (the army calls it a pistol belt) and a bunch of ammo pouches designed to

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clip onto it. Each pouch now comfortably carries its own remote transmitter. I feel slightly embarrassed by this because, when decked out with remotes, I look a little like Batman and his utility belt—less the cowl and cape. Still, the remote-control revolution has left me few alternatives. In fact, I have practiced drawing remotes from their holsters the way cowboys practice with their six-shooters. As a result, I can now turn on my TV set from ten paces faster than anybody east of the Hudson River.

Thanks to the new technology of remote control (pulse-coded, infrared-carried), systems are now capable of performing more operations than a plastic surgeon with a gambling problem. The Zenith Computer Space Command 5000, for example, is standard equipment on the company's 45-inch projection television set. Among the functions of this remote control are direct access to any of 112 channels, station scanning, raising and lowering of the screen into its cabinet, muting, stepless volume control, and telephone dialing through the set's Space Phone interface. This one remote will turn a sideboard into a TV set, tune in the football game, then, later, let you call your bookie to tell him you'll be a little late paying up. It will also let your wife call the hospital to check on your condition—all this without missing a moment of "General Hospital."

If cost is no object in your quest for the latest in remote controllability, Sony will sell you a magnificent 30-inch-screen TV console with remote for a cool $10,000. The set's remote permits adjustment of color and brightness in addition to the usual functions. For the price, though, you'll also get an on-screen bar display of the relative status of each setting. Sony also has gone all out and thrown in a second remote transmitter should you and the spouse ever get a hankering to play Dueling Channels. (For a few thousand dollars less, Samsung, a Korean TV manufacturer, offers a remote that will also increase or decrease color and brightness, without the on-screen display.)

For the terminally lazy, there are remote-controllable hi-fi systems that will do just about everything. Many, if not most, hi-fi companies offer at least one cassette deck with duplicate tape-drive controls (stop, record, play, etc.) on a remote key pad—usually of the wired variety. Several manufacturers—JVC, Sony, and Fisher, among others—produce complete component systems that are remotely controllable. Here, the idea is to run the tape deck's drive functions, start-stop and cue the turntable, select stations on the tuner, and control power and volume on the amplifier—all by remote. It is also possible to switch signal sources, but less frequently used controls—tone, balance, loudness, etc.—are usually omitted from the remotes.

In hi-fi, however, the non-standardization of remote-control codes means that you must choose between buying all components from a single manufacturer (and so, have one hand-held control for everything in the system) or mixing separates (different manufacturers) and settling for a different transmitter for every component.

If there is a solution to this incompatibility of remotes, it may be in the form of a universal system—one that can impose its own control over any appliance. Such a system is now available; presently it can do no more than turn electrical appliances on or off and dim incandescent lamps. The system was originally sold as the System X-10 by BSR, but many other companies have begun offering their own models as well. Happily, all the systems are quite compatible.

> "For the terminally lazy, there are remote control hi-fi systems that will do just about anything"

Operation is simple. A central control box sends a pulse-coded signal through your home's AC electrical network to remote modules that are plugged into AC receptacles. All modules, in turn, have a lamp or appliance plugged into them. The signal sent by the central controller contains two elements: an address code and a command. You pre-program the address codes into each module and, by setting the same address on several modules, groups of lamps or appliances can be controlled by a single button. Systems are limited to 16 to 256 address codes, depending on which brand you buy.

For under $25, the control of the system can be extended beyond the central controller box: A cordless transmitter permits mobility within line of sight and a reasonable distance from the controller by using an ultrasonic carrier signal.

But perhaps the most remote of all controls was introduced recently by BSR: For less than $100, your modules can be connected with a telephone controller that permits you to turn off the toaster in your home in Dubuque from a phone booth in Sri Lanka. A telephone transmitter, similar to those used with remote-controlled phone-answering machines, sends coded signals by phone to the box at home.

If variety rather than distance is your goal, Radio Shack now offers a $39.95 computer interface for its variation on the X-10 system. The interface will permit one of the company's TRS-80 computers to control up to 256 modules. The computer program is also capable of sending commands on a complex schedule or in response to input data from sensors scattered around your home. The computer might shut off the blender when the phone rings, for example, or turn on an "umbrella warning light" when it rains, or even ring a bell when baby wets the bed.

Want more? There's the X-10-compatible ECM Centurian. It's a solenoid-controlled water valve (under $60) that can be connected to a garden hose (for those really lazy days of summer). Or, if you have grander visions, there's a plumbing-fixture model for inside the house. Remote-control bath, anyone? Not content with this single foray into the wonderful world of remote-control whimsey, ECM is threatening to manufacture a pet-feeder module. Should you remember, in the midst of a vacation (say, "A Gourmet's Tour of the Great Diners of Holland"), that you forgot to leave food for the iguana—and should your system be equipped with a telephone interface—you can remotely trip the feed mechanism and continue eating your way across Holland in peace.

Also from the inventive folks at ECM is a thermostat module (24 VAC) that permits remote switching between two preset temperatures. Using the telephone interface, you might call home to warm up the house just before leaving the office. And, if toying with temperature is your thing, Regency Electronics offers a full line of HVAC (heating, ventilating, air conditioning) modules rated at three amps at 24 VAC to 30 amps at 240 volts and priced from $19 to $50. All of these modules are X-10-compatible.

The future of remote control, meanwhile, looks very light: You won't need to carry anything but your voice. Quite a few companies are working on voice-recognition systems that can convert spoken commands into electrical signals. Exactly what form the remote version of this system will take, it's too soon to say: Microphones will either be scattered around your house, or you'll have to learn to shout—but not so loud that the neighbors' house will hear. HS

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Camping gear for the "less-is-more" '80's

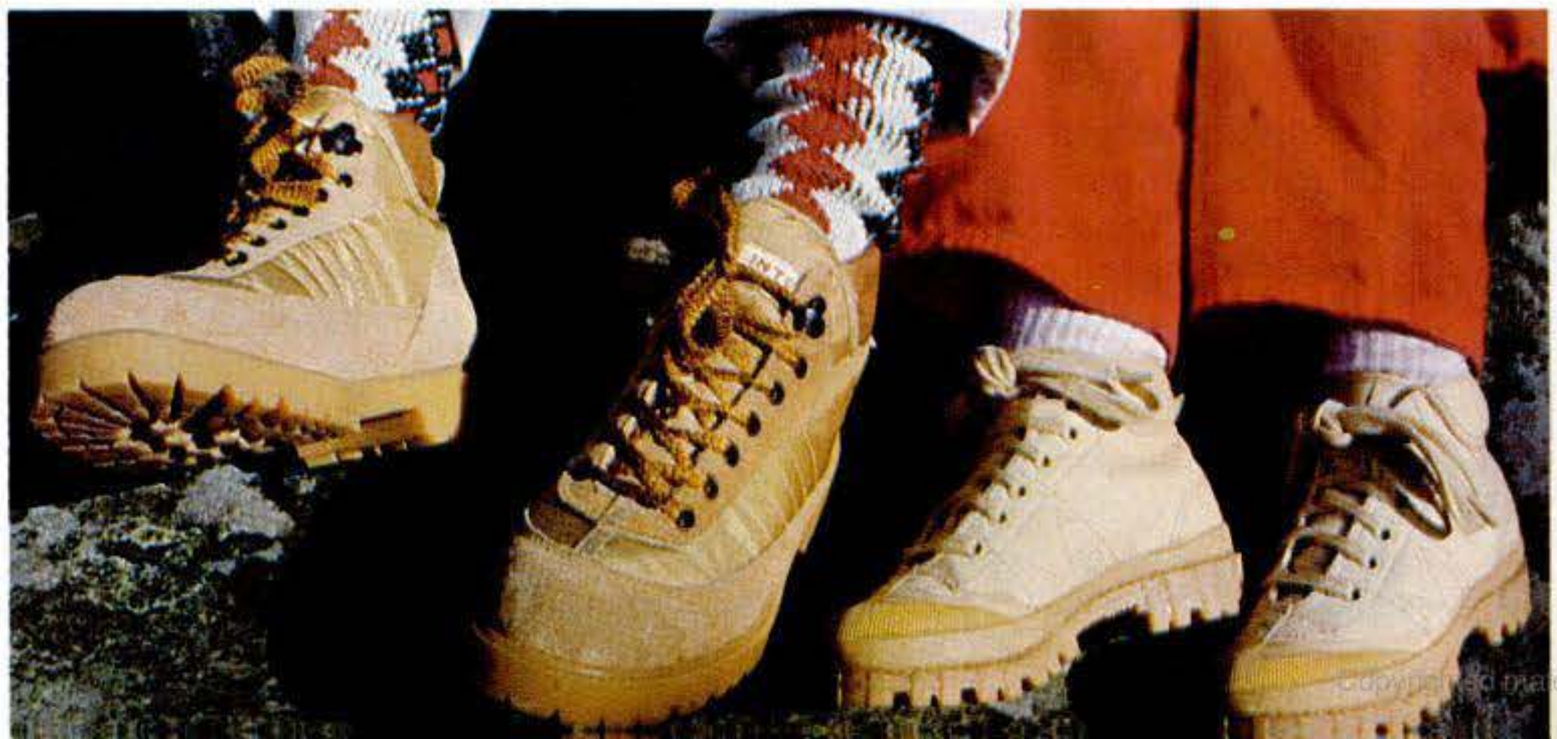
Two-person tents of ripstop nylon pitch and pack in a fuss-free jiffy. The Wilderness Experience Sanctuary (left) from L.L. Bean uses fiberglass hoops to form a 43-in.-high dome. The floor is 89 by 62 in. Weight with waterproof fly: eight lbs.; price: $198. Sierra West's Skylite tent (right) weighs only 4¼ lbs. It's 50 by 104 in. and 38 in. high. Netting roof lets you sleep under the stars; in foul weather, add the waterproof fly ($200 from Eddie Bauer). Segmented orange foam pad covers rocks and damp ground to form a cushy seat or mattress. The 57-in. Fold Pad ($20 from Early Winters) won't absorb water, stiffen in cold, or age in sunlight. The modular Liberty pack from Lowe Alpine Systems ($220) has an internal X-frame. The divided back pocket zips off to become a day pack; the top pocket becomes a fanny pack. Zip both together for mid-size loads.

New designs save weight, bulk—and money

By V. ELAINE SMAY
PHOTOS BY JOHN KEATING

Weight and bulk are the natural enemies of the camper, and the major weapon against them has been new-technology materials. Now there seems to be a new philosophy stalking them, as well. It springs from the realization that most campers don't need gear fit for a Himalayan expedition. Prime examples of its manifestation appear in our 1982 collection: lightweight boots (they began to appear when droves of hikers sought comfort in running shoes); a subcompact sleeping bag (it won't do for the Arctic but it's fine to about 35 degrees); and small but rugged lights.

There are bonuses to this minimalist approach: For one, it costs less; for another, you have room for a little luxury—perhaps a shower bag, a thick paperback, or a bottle of wine. PS



Lightweight boots are easy on feet—and budget. Sierra Hikers (left in photo) have nylon uppers with water-repellent suede reinforcement. Yak Works has them in sizes 5½ to 13 for only $34. Child's boots, the Kidaroos from Early Winters, are made of washable, water-repellent cotton canvas for sizes 13 to 3; $20.

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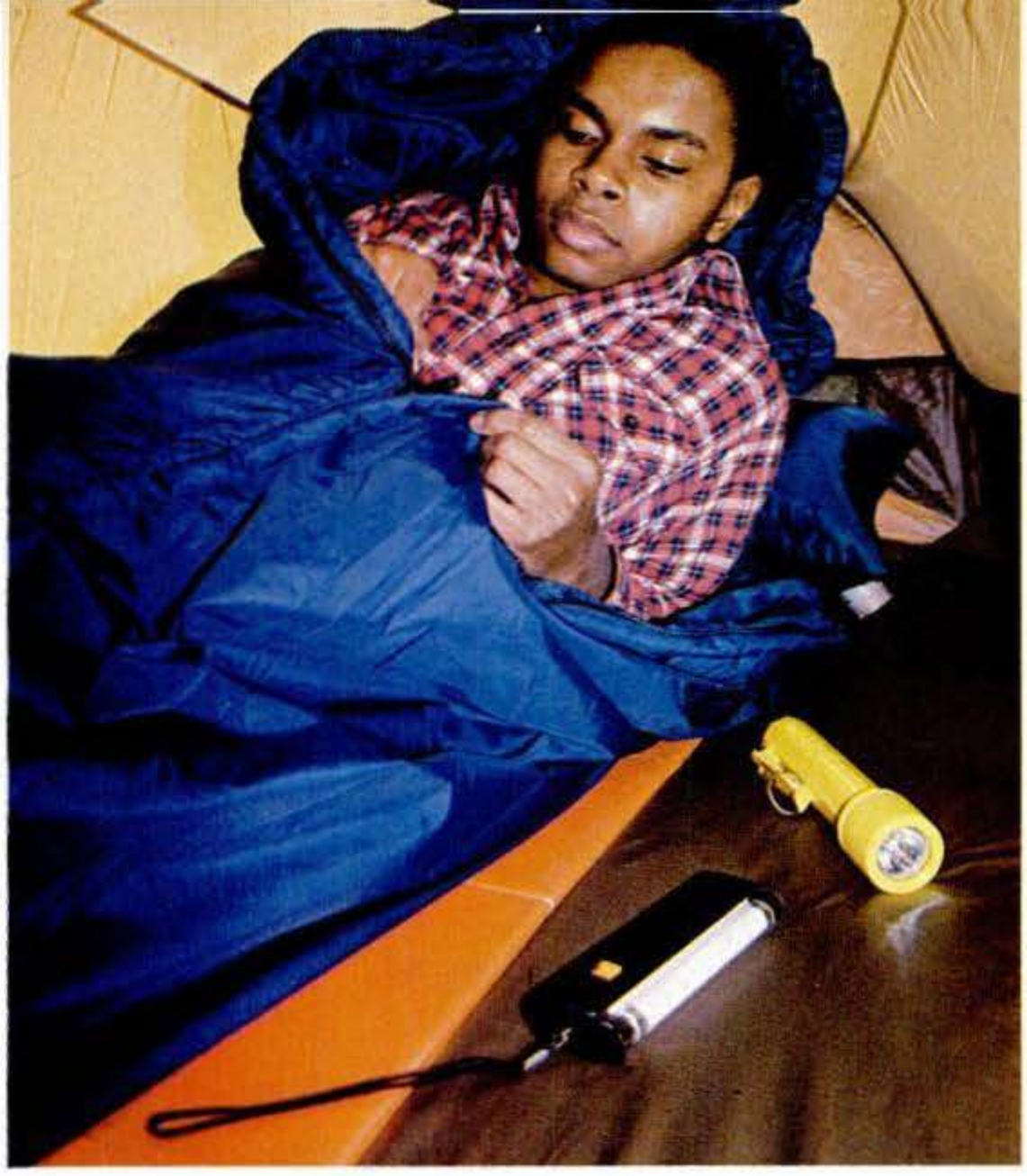
Thirsty? Just unclip and sip, says Early Winters. Its Water Line ($10) is a long, vented plastic straw that clips to your strap or shirt and leads to a one-qt. bottle ($2.10) in your pack. For showers at camp, Yak Works sells the Water Bag (hanging) with a new Shower Power hose ($8). Pressurized shower for car, boat, or cabin is yours with the Water Caddy ($40 from Early Winters).



Tiny, 2½-lb. sleeping bag from Yak Works (right and above) is dwarfed by a traditional synthetic bag (red). Yak Sak's lining is 3M's Thinsulate insulation; a metallic membrane retains radiant heat. Price: $70. Yellow flashlight has a quartz-halogen bulb for a 10-times-brighter beam (Early Winters, $30). Fluorescent camp light, the LunaLite, is $15 from Yak Works.

Detachable pad on the red Drag'n pack ($37.50 from KSJJ Ind.) can be used as a seat cushion. Green pack is Coleman's Peak 1 large-capacity day pack; $33.50. Right photo: Portable LP-gas grill, Charmglow's Bantam ($100), packs in car or boat.

BEACH & BARNES

Makers and distributors: Charmglow Products, Box 127, Bristol WI 53104; **Coleman Co., Inc.,** 250 N. St. Francis, Wichita KS 67201; **Early Winters, Ltd.,** 110 Prefontaine Pl. S., Seattle WA 98104; **Eddie Bauer, Inc.,** 1737 Airport Way S., Seattle WA 98134; **KSJJ Ind.,** CPO Box 1369, Kingston NY 12401; **L.L. Bean, Inc.,** Freeport ME 04033; **Lowe Alpine Systems,** 802 S. Public Rd., Box 189, Lafayette CO 80026; **Sierra West,** 6 E. Yanonali St., Santa Barbara CA 93101; **Yak Works,** 2030 Westlake Ave., Seattle WA 98121.

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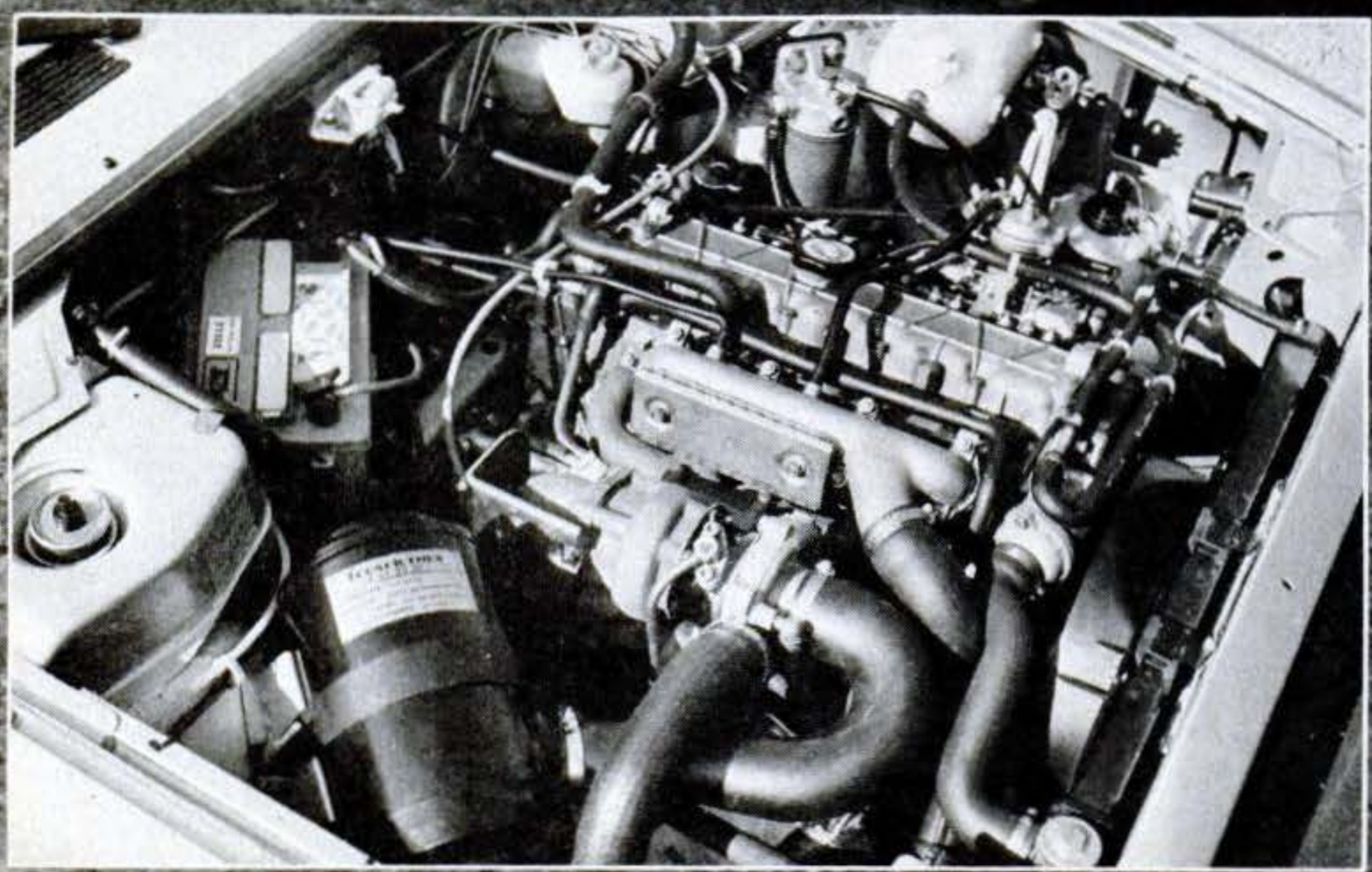
Diesel RV's
lead a parade of new high-mpg campers



Unique van conversion from Winnebago is built on a chassis the company designed itself. It's powered by a two-liter turbocharged Renault diesel (inset) and employs a Renault front-drive power train. The van conversion will seat eight, sleep four persons. Winnebago will certify the RV with the EPA and is aiming for 20+ mpg.

Can a 22-foot pocket motor home get over 20 mpg? Yes, says one maker

By HERBERT SHULDINER

LOUISVILLE, KY.

A magician's tricks brought smiles to the faces in a crowd of dealers at Chevrolet's huge exhibit at the annual recreational-vehicle industry show here. But the magic act wasn't all the dealers had to smile about. For parked behind the magician was Chevy's all-new 6.2-liter diesel-powered motor-home chassis. The Chevy engine and other diesels from Europe and Japan scheduled for introduction in dozens of 1982 models herald a new generation of more fuel-efficient camping vehicles. That's just what many prospective RV buyers have been waiting for.

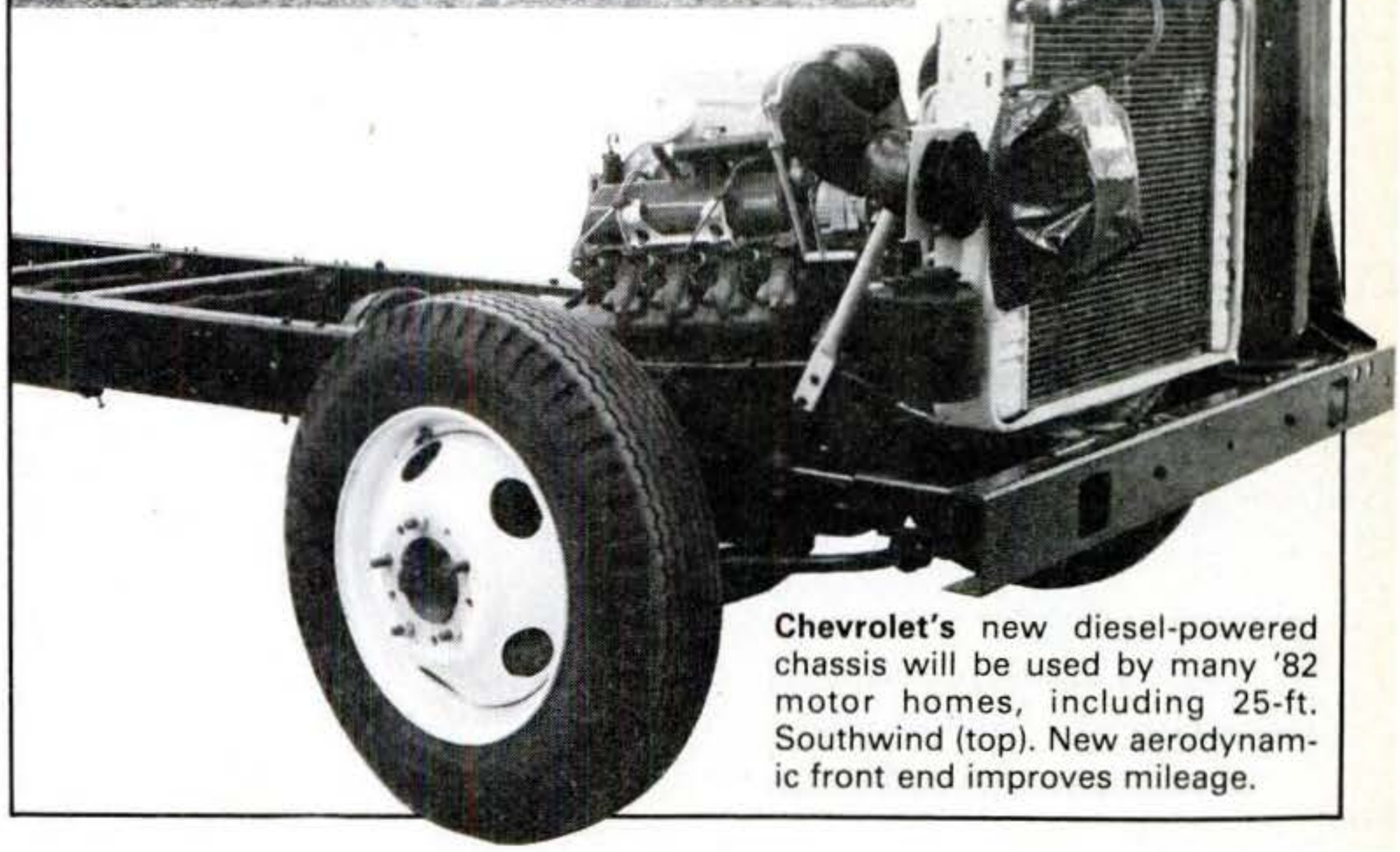
The new diesels, more streamlined designs, and use of new materials and building techniques to achieve substantial weight reductions make the '82 RV's the most efficient yet.

Virtually all of the top motor-home makers, including Champion, Coachmen, Fleetwood Enterprises, Midas, and Winnebago, plan to start building 22- to 26-foot-long motor homes on the diesel-powered chassis this spring.

John F. Sillick, manager of Chevrolet's special-vehicles department, told me the chassis will accommodate motor homes rated at 10,500 to 12,300 pounds GVW. "We expect the diesel engine to produce a 25 to 30 percent fuel-economy improvement over the 454-cu.-in. gasoline V8 now used in our motor-home chassis," Sillick says. As this issue went to press, however, no motor-home maker had a production model that had been tested for fuel economy. (Fuel economy for most gasoline-powered motor homes in this weight bracket now ranges from seven to 12 mpg. RV manufacturers told PS they expected the diesel to add $2,500 to $3,000 to the cost of a motor home.)

Chevrolet's new S-10 pickup truck, also powered by the 6.2-liter diesel, is the platform for a new mini motor home from Coachmen. The Coachmen 20-foot Caper mini is actually a chassis-mount camper. A 23-foot model with a tag axle and diesel option will also be available this spring. Coachmen's Gene Stout says the company is aiming for 18 mpg with the 20-foot camper.

An Isuzu turbocharged 6.2-liter diesel is offered by Holiday Rambler as an option in 26- to 33-foot-long motor homes. "It increases fuel economy from seven to 12 mpg," claims Al Slabaugh, sales manager for Holiday Rambler. The Japanese-made diesel, however, adds $10,000 to the price of Holiday's motor homes.



Chevrolet's new diesel-powered chassis will be used by many '82 motor homes, including 25-ft. Southwind (top). New aerodynamic front end improves mileage.

Coachmen's Caper mini motor home is mounted on Chevrolet's new S-10 pickup truck. It comes with automatic transmission and a diesel-engine option.

Bidding for honors as RV fuel-economy champ this year is a Winnebago van conversion now code-named Centauri. It won't be available until this fall. The RV is built on a Winnebago chassis, with a turbocharged diesel engine and front-drive power train supplied by Renault. Winnebago's chairman, John K. Hanson, says his company will certify the RV with the EPA and is aiming for a fuel-economy rating of over 20 mpg in highway driving as rated by the agency's tests.

Centauri seats eight, sleeps four, and has minimal galley facilities. It measures 22 feet long, seven feet wide, and seven feet tall. A dropped center floor provides six feet of interior head room. The new Winnebago will be sold only through new-car dealers, Hanson says. Price: in the $20,000 range. PS

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Yard blowers
blast trash in a flash

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Forget rakes and brooms —blow yard debris away with these lightweights

By E. F. LINDSLEY

Power blowers, the hottest outdoor power tools since string trimmers, have suddenly mushroomed in a wide variety of models: gas and electric, hand-held and backpack, even combination blower/vacuum types. Delighted users have discovered that a blower is really a grab-and-use rig and they're constantly finding new uses for its potent air blast.

Big commercial blowers were first used by stadium and park cleanup crews, but new household models are lighter, less expensive, and ready to go at the tug of a starter or flip of a switch. You can:

- Ferret leaves and trash out of hedges and fences.
- Blow grass clippings off your driveway or heavy windrows off your lawn.
- Clean debris off patios and porches.
- Blast light snow from walks and steps.
- Force accumulated leaves from gutters and roof valleys.
- Get rid of webs and loose dirt before painting.
- Vacuum garages, basements, porches, and pool areas.
- Even fan the coals in charcoal grills before cooking.

But that gust of wind comes from a variety of different machines. Some come as backpacks you strap between your shoulders; others are hand-helds to tote in one hand; and one is a ground-level type you push like a vacuum cleaner. Power can be a husky—or a modest—two-stroke engine, or an electric motor with trailing cord. Conversion to vacuum use can be instantaneous or bothersome. And prices range from less than $100 to several hundred dollars.

Recently, I got a chance to test a number of these new models from companies such as Homelite, Toro, and Echo. Conclusion: If you own a football stadium, stick to larger commercial models. But for most home uses, these lightweights will do the job. Here's what I found:

Power blowers for the home are lightweight and easy to use. Author's son holds the Echo PBAV-400; other models seen counterclockwise from left are the Toro 30940, Echo PB-200 and PB-202, Homelite HB-280, Weed Eater 2500, and Paramount PB-300. Leaning against the tree is the K&S Windbroom.

Yard blowers for '82—how they compare

Brand name	Model	Type	Power	Power or eng. disp.	Vacuum feature	Weight (lbs.)	Price (approx.)	Remarks
Echo	EB-9000	Hand-held	Electric	0.9 hp	No	7	$70	Hi-low switch
	PB-200	Hand-held	Gasoline	21 cc	No	9.7	$130	
	PB-202	Backpack	Gasoline	21 cc	No	11.9	$240	
	PB-400	Backpack	Gasoline	40 cc	Opt.	22.5	$300	Vac Kit, $49.95
	PBAV-400	Backpack	Gasoline	40 cc	Yes	23	$350	Bag holds 7–10 gal.
Homelite	HB-280	Hand-held	Gasoline	26 cc	No	11	$190	
	HB-480	Backpack	Gasoline	26 cc	No	13.5	$220	
	HB-680	Backpack	Gasoline	26 cc	No	16.5	$260	Blower/mist/spray
K&S	Windbroom	Hand-held	Electric	1 hp	No	7.1	$50	Push-along use
Paramount	PB-80	Hand-held	Electric	1/3 hp	No	5 (est.)	$50	
	PB-100	Hand-held	Electric	1 hp	Opt.	7	$65	
	PB-300	Hand-held	Electric	1 hp	Yes	7+	$95	Hi-low switch
Stihl	SG-17	Backpack	Gasoline	56 cc	No	17.5	$300	Blower/mist/spray
Toro	30940	Backpack	Gasoline	40 cc	No	22.5	$300	
Vandermolen	55	Backpack	Gasoline	3.33 hp	No	23	n.a.	Commercial model
Weed Eater	2500	Hand-held	Electric	n.a.	No	6.5	$34	

Backpacks

In this group, Echo's PB-400 is outstanding with its nifty lever that flips instantly from blower to vacuum. Blast porch debris, leaves, or grass into a corner, hit the vacuum lever, and suck it all up into the bag. Most important, it's all done with a venturi action, and the inevitable pebbles and twigs don't pass through the blower impeller.

But great as backpacks are for serious work, they have disadvantages. Adjusting the straps and swinging the whole rig up onto your back is not easy. You first put the thing on your back and adjust the straps for your size. Then you take off the whole outfit and start the engine. Finally, you wriggle back into it with the engine running. It's not easy; and even with padded straps, backpacks get heavy.

Hand-helds

The hand-helds, with smaller gas or electric power plants, are not quite as potent as backpacks, but they can't be beat for handiness. I'd often snatch up a little hand-held when I wouldn't bother getting into a backpack. But that still leaves a choice between electric and gas power. Surprisingly, the electric models perform very well. I tried an electric in one hand and a gas-powered blower in the other. After watching the debris fly, I had to concede the choice was a tossup for most jobs.

Electric blowers, of course, don't require mixing oil and gas, and they switch on instantly without pulling a starter. But I find it a pain to pull a 100-foot extension cord around the yard—then coil it up again when I'm through. My choice for quick, immediate use is a gas-powered model such as the Echo PB-200 or Homelite HB-280.

Among the electrics, the Weed Eater Model 2500 is about as basic as you can get, and it's light, simple to use, and effective.

Another electric, the Paramount PB-300, has extra features including a HI-LOW motor control and an adjustable air-inlet gate—very practical when you don't want a full-powered blast. Unfortunately, Paramount's vacuum attachment is not easy to mount. And when you remove it, you're left with a number of small parts to store. Even worse, the dirt it picks up goes through the plastic impeller—and could cause damage.

All of the above blowers use sections of plastic pipes plus fan nozzles to spread the air stream. You choose the pipe length and nozzle to suit the job. The handling technique is as simple as aiming a hose. But Echo's PB-200 has a little stubby nozzle available that gets rid of the long pipe; you simply swing the whole blower. For most purposes it's all you need.

The K&S electric Windbroom is entirely different. The motor is at ground level—no need for pipes—and you roll it by pushing its handle. The air jet emerges low and flat to the ground—probably the most efficient way to direct air for cleanup on flat surfaces such as drive or patio. But for blowing out eaves, for example, the Windbroom is less useful.

Summed up, I found all the blowers I tried capable within their intended range, but each had good and bad features.

If you need power, the backpack models are for you. But if you require a quickie cleanup tool, try the hand-helds. The choice between electric or gas-powered models comes down to individual preference. PS

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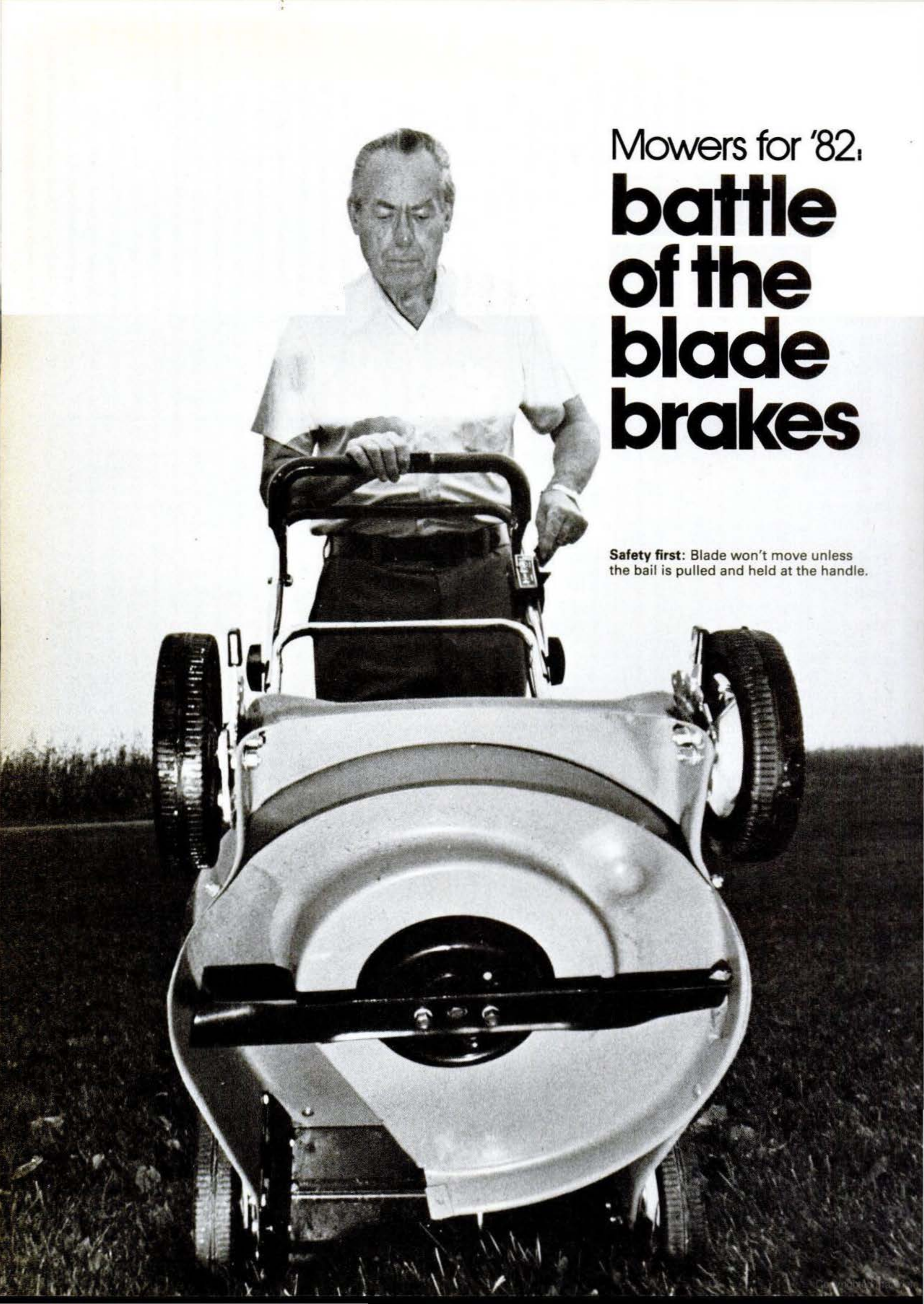


Mowers for '82:

battle of the blade brakes

Safety first: Blade won't move unless the bail is pulled and held at the handle.

Three distinct types are being sold. Which should you put your money on?

By E. F. LINDSLEY

It's now law: Walk-behind mowers built after June of this year must be equipped with a blade-brake device. It will add some to the price of these machines, but a lot to their safety.

A blade brake stops the whirling cutter blade within three seconds after you release the mower handle. That makes it nearly impossible for you to leave the cutting position and accidentally touch a 200-mph nightmare.

But all blade-brake systems are not equal. There are three distinct types, and each offers trade-offs in cost, convenience, and, probably, reliability:

- Engine stop and electric restart—most expensive, fairly handy.
- Engine stop and manual restart from operator's position—lowest cost, most inconvenient.
- Blade stops, engine runs, using an automatic clutch brake—medium cost, convenient, mechanically complex.

To make a wise choice if you're buying a mower this year, you need to know some facts—why blade brakes became law and the differences between them. For now, major mower makers, such as Homelite (Jacobsen), Lawn-Boy, and Toro, offer all three systems. That makes the choice all yours—and it will come down to a battle of the blade brakes.

Why blade brakes at all?

Blade brakes resulted from a study by the Consumer Products Safety Commission on how most mower accidents occurred. Many happened when the operator tried to remove grass or debris from the discharge chute or bagging outlet with his fingers. Other accidents occurred during starting, bag removal, or just stopping to pick up lawn trash. Opponents of the blade brakes argued that no one with common sense would put his fingers or his feet in the path of a whirling blade. Perhaps, but the facts were that the accidents went on in spite of various guards, educational programs, and warning decals.

The logic was inescapable; accidents centered on the operator trying to do something after leaving the mowing position while the blade was still turning. One of the biggest factors was the operator's reluctance to manually stop and restart the engine. But other accidents resulted when the engine was started: Pulling a rope on the engine places your feet near the blade.

The conclusion, reached reluctantly, was that the blade had to be stopped before anyone could move from the handle to the blade area. And the starting system had to be designed to force the operator to stand away from the blade—or the system had to start the engine without turning the blade at all.

To meet these requirements, designers had to compel the operator, while mowing, to hang onto a control in order to keep the blade turning. That much was easy. Almost any type of bail or swing handle with a light spring would work. But making a brake that would snub down the mass of the engine and blade almost instantly was a job for the engine builders.

Electric restart

Both Briggs & Stratton and Tecumseh came up with brake systems that worked on the flywheel similarly to the brake on a car wheel [PS, April '81]. But that was just the beginning. For example, new electric starters were needed that could take, not several, but hundreds of starting cycles as you stopped and restarted for bagging. And multiple starts demand batteries with sustained zip and durability. This required a built-in alternator for battery charging while mowing. And, of course, none of that would work without wiring, switches, linkages, diodes to provide DC for the battery, and a charger in case the battery went dead in storage. Naturally, this raised the cost of the mower. Most manufacturers project $50 to $75 extra for a blade brake with electric restart.

Nevertheless, electric restart may be a fairly popular consumer choice. It may also be pushed more by mower manufacturers for quite another reason. Many companies are relatively small and buy the engines separately. If the brake is contained on the engine—and something goes wrong—it's the engine company that gets sued. As one spokesman told me, "We'd rather have the liability on the engine builder's back."

Manual restart

For those who balk at the cost of electric restart, the answer may be remote manual start. Many call this "zone start" since it forces the operator into a presumed safe zone while starting the engine.

Zone start still uses the bail grip on the handle; you must hold onto it to run the mower. It also uses the brake on the flywheel to stop both the engine and blade. But it doesn't require the expensive electric starter system and battery. Instead, the starter rope is extended partway up the mower handle. The only comfortable way to pull it and hold the grip is to stand behind the mower, far from the blade.

Briggs & Stratton estimates the zone-start rig might add about $12 to the cost of a mower, but others claim it's more like $15 or $20. Either way, it's still the cheapest system and will probably be used widely on the lower-cost, mass-marketed machines. Zone start, according to Toro's Lyle Fanning, "will probably be best suited to users who don't make frequent stops for bagging."

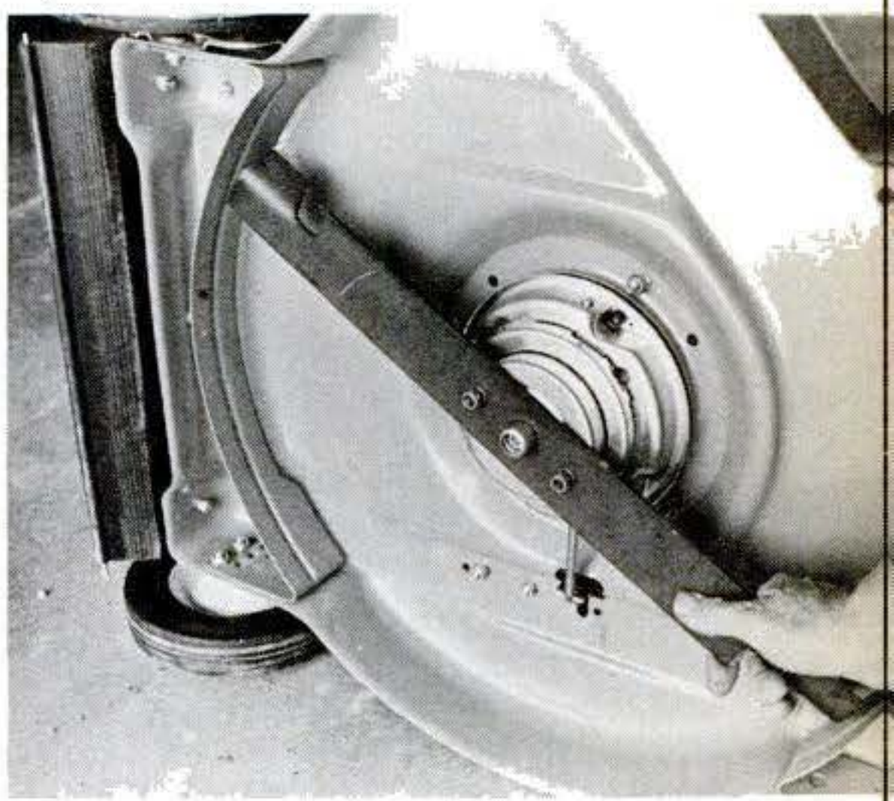
Naturally, you must examine your own mowing habits. The trade-off with this system, of course, is some inconvenience. It's also possible that a youngster or elderly person might have trouble with frequent manual restarts.

Clutch brake

Clutch brakes occupy the middle ground: They're expected to cost less than electric restart but more than zone start. Most makers estimate an added $30 to $40. That's because starting is done as it is now—just once, and from the conventional position. But while the engine starts, the blade doesn't turn. You must move an engaging lever to start the blade turning and hold down a bail to keep it going. Let go, and the blade is braked and the engine declutched in less than three seconds. The engine keeps right on running.

This is a big improvement over the original centrifugal clutch brake, which required starting the engine at idle setting, a condition that many engines balked at. Today's clutch brakes permit starting at any throttle

[Continued on page 132]



Clutch-brake mechanism is complex. Can it fail over time? Makers say it won't; mower builders aren't sure.

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What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS

Solar cycle

A team of amateur engineers in Cologne, West Germany, modified a shopping tricycle to operate on solar cells. The sun roof has four modules, each equipped with 36 cells. A DC motor delivers 132 watts in direct sunlight. Three gears handle start-up, hills, and cruising speed.

Cup warmer

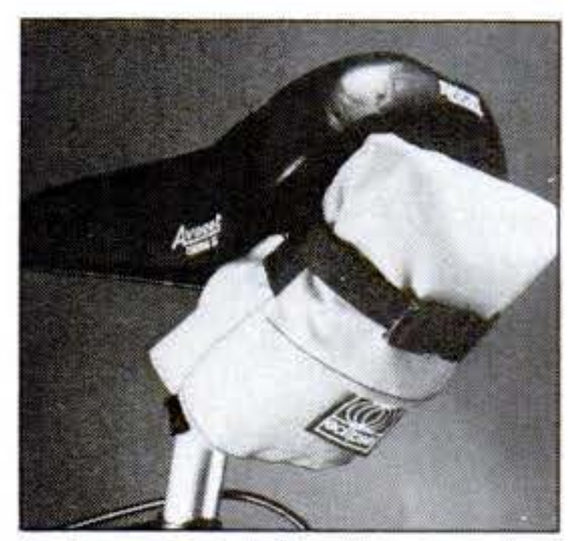
Tired of tepid tea, coffee, or soup? Cup Cake heats beverages and automatically shuts itself off when you lift the cup from its surface. A magnetic switch activates the heater. It's made by People Products Co., 131 Southwest 156 St., Seattle, Wash. 98166.

No-slip goggles

Swimmers who lose goggles or caps during dives or turns won't have that problem with Goggl'cap, according to its inventor. The swim cap is welded to the goggles so they hold each other in place. $11. American Ace, Box 632, Jasper, Ind. 47546.

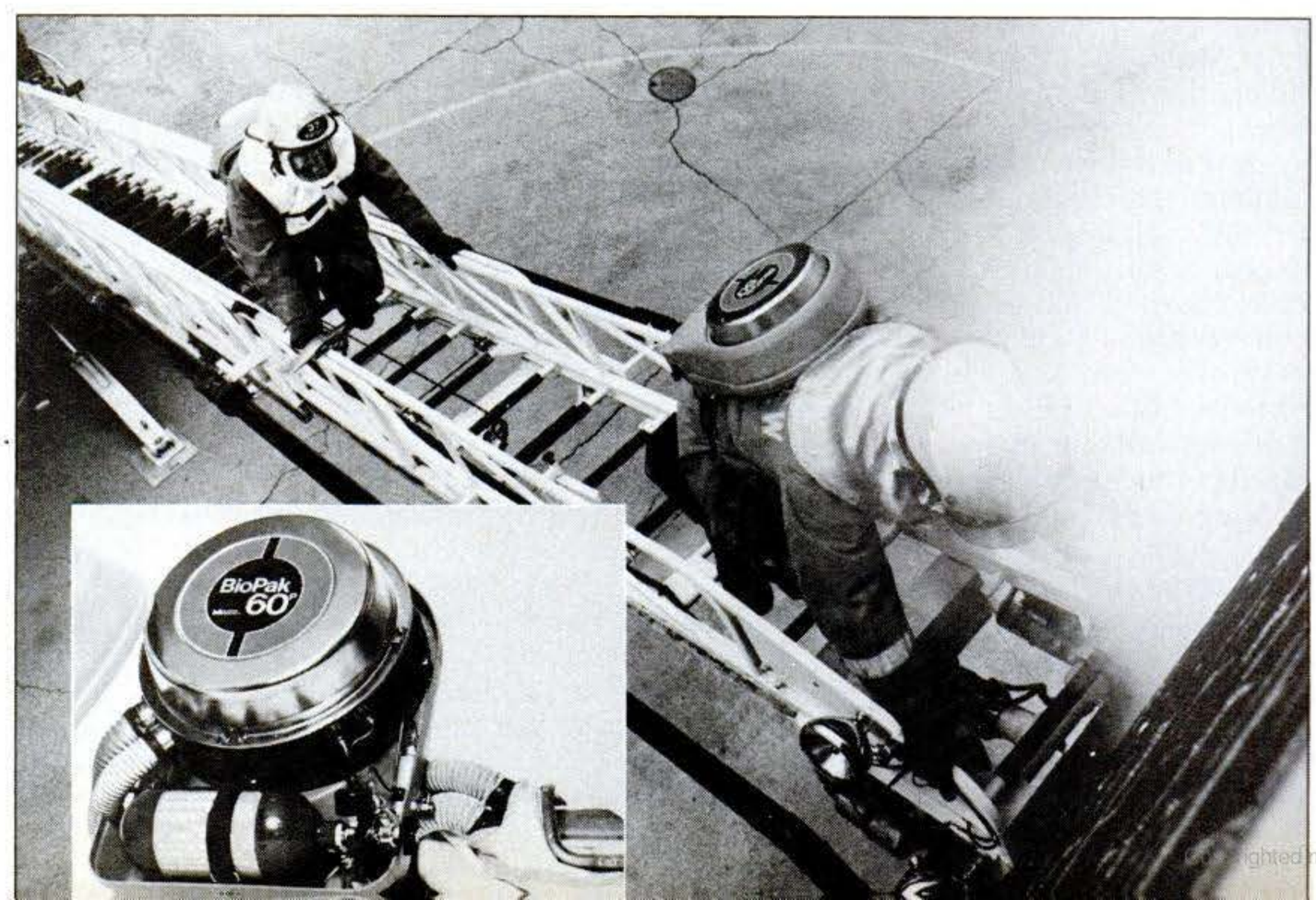
Bike bag

Strap Bike Pocket beneath the seat and you'll have room for spare-tire gear, tools, and the wallet that can slip out of your pocket, says Eclipse Inc. (Box 7370, Ann Arbor, Mich. 48107). A quick-release buckle speeds removal. The handy nylon bag (three colors) is $9.



One-hour O_2 pack

Firefighters can use BioPak, a self-contained breathing apparatus, for up to one hour, says the maker (Safety Products, Malvern, Pa.). BioPaks have a small oxygen bottle, but recirculate and filter exhaled air for reuse. A one-hour model weighs 25 lbs.



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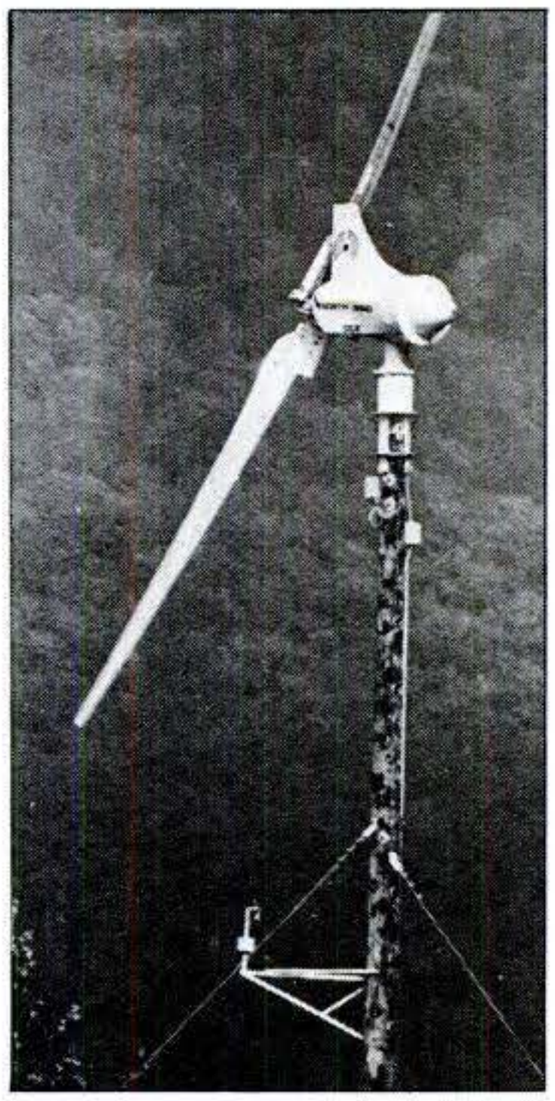
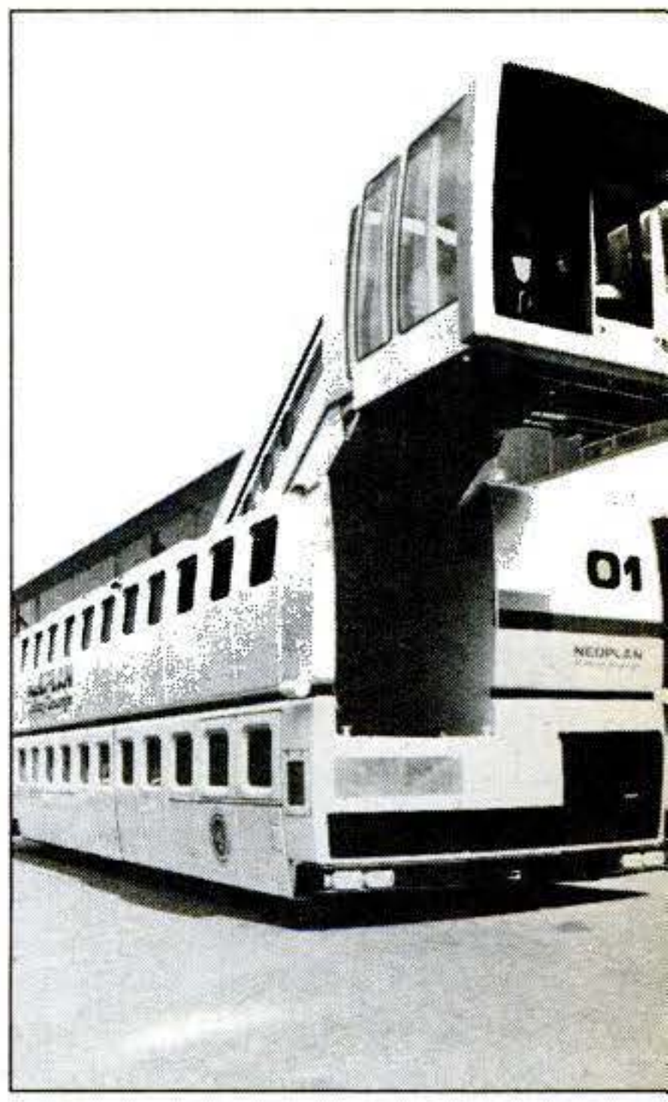
Dual-role jetfoil

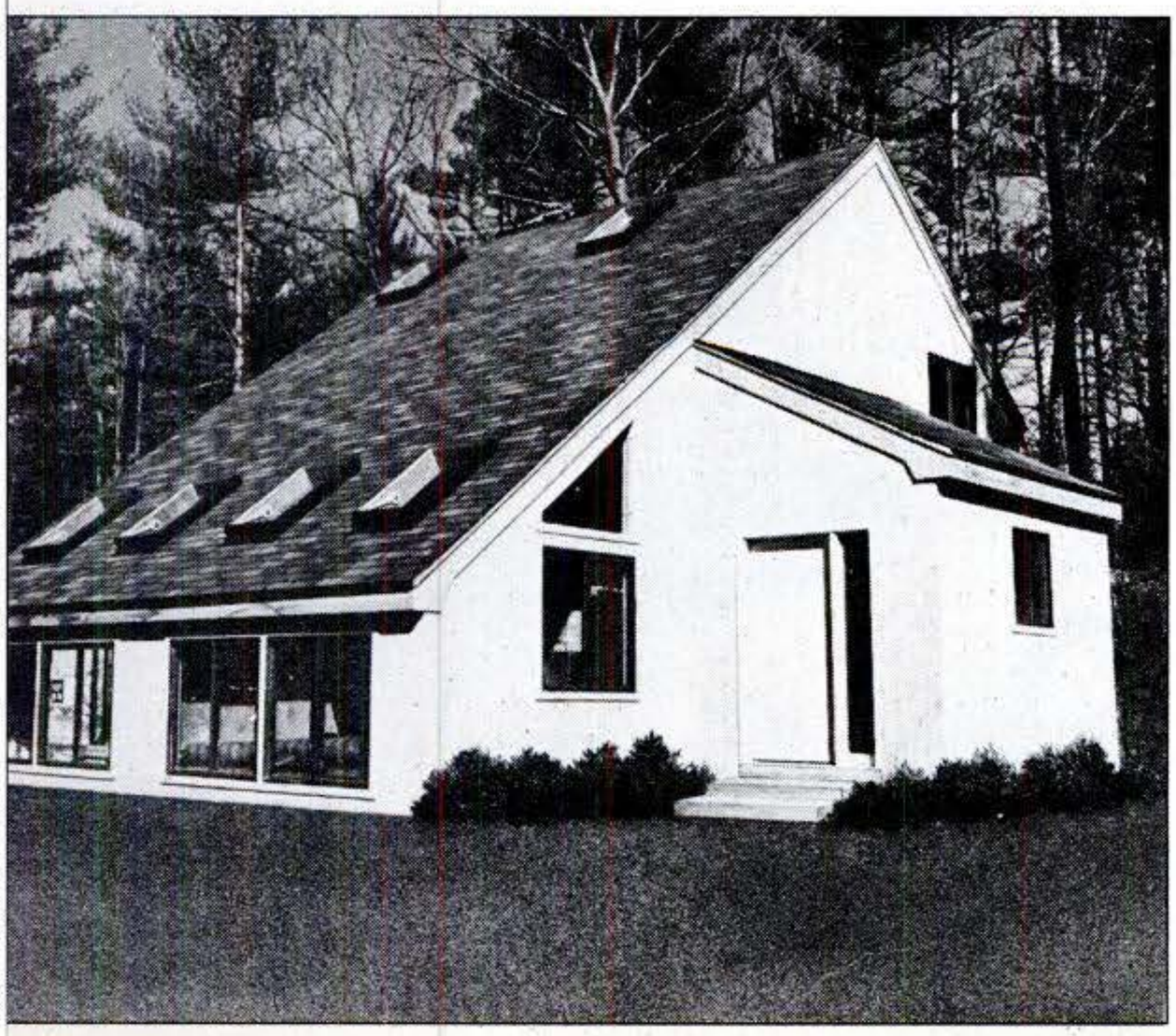
A Boeing jetfoil sold to Indonesia (above right) maneuvers with another hydrofoil for the U.S. Navy. The Indonesian model will have two roles: coastal defense and customs enforcement or, after quick interior changes, offshore-oil missions.

Four-kW windmill

A prototype four-kilowatt windmill designed for residential or utility use is being tested by North Wind Power Co. (Box 556, Moretown, Vt. 05660). Slated for midyear sale, the machine puts out 1,200 kWh per month with 10-mph average wind speed.







Passive-solar home

Fuel bills busting your budget? Two new passive-solar-home designs from American Barn Corp. (S. Deerfield, Mass.) capture, store, and distribute the sun's heat. The company offers designs with 1,548 and 1,848 sq. ft. of living area, single- or multifamily units.

Airport bus

Double-deck airport bus carries a jumbo-jet load of 324 passengers. An integral walkway tunnel extends and elevates for docking with the arrival and departure levels of terminal buildings, as well as with aircraft doors. The German-made Neoplan Galaxy Lounge is 49 ft. long.

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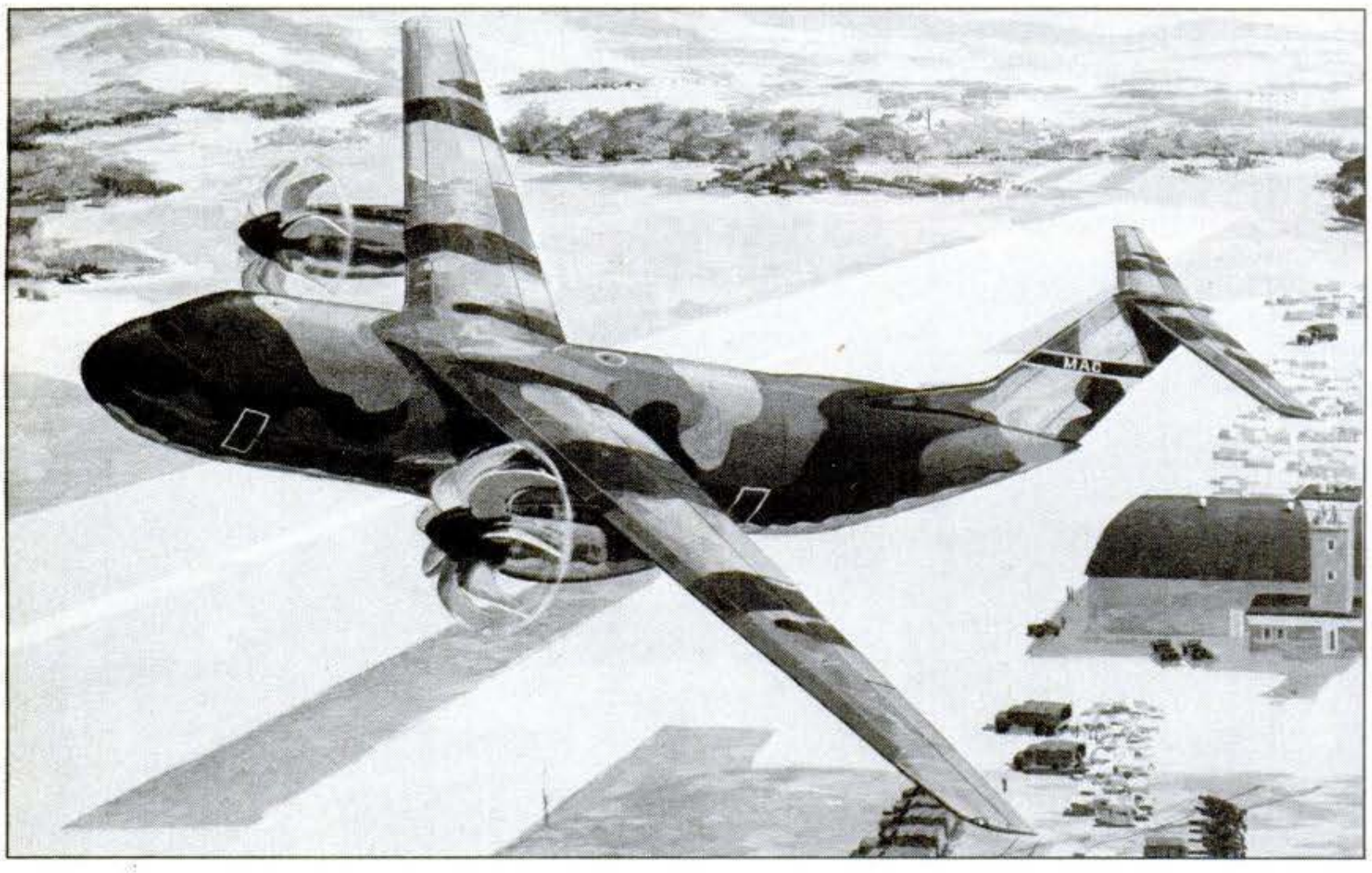
What's New

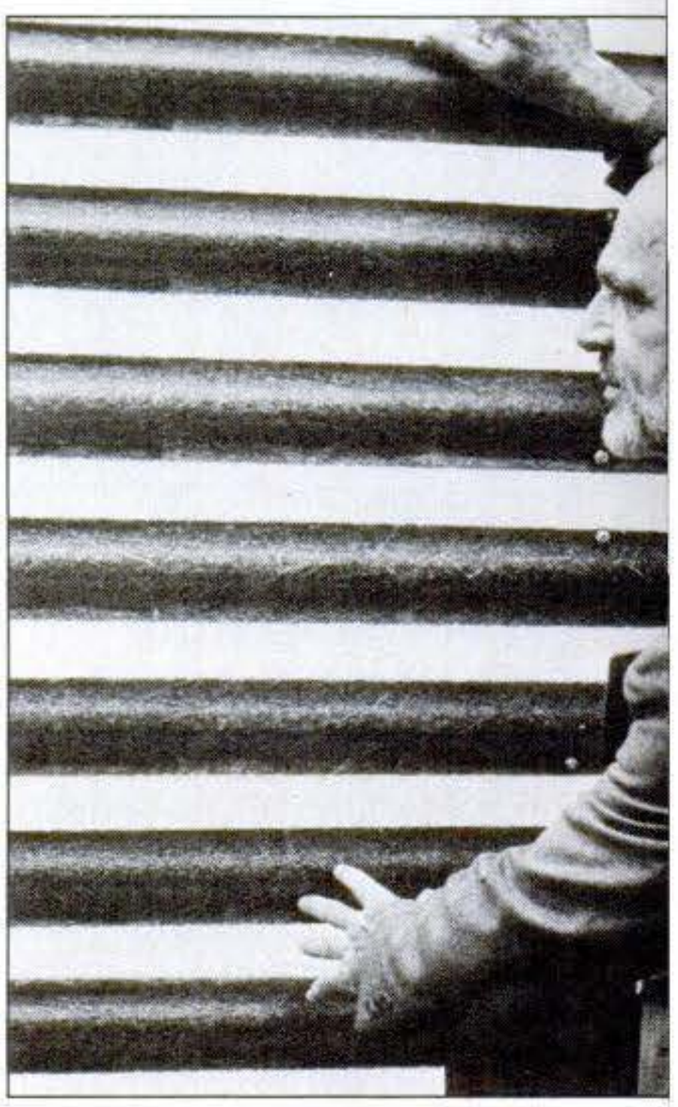
Twisting truck

Double-jointed Chico keeps both axles on the ground, even on steep grades. Powered by a 35-hp, tail-end diesel, the go-anywhere truck also floats—and does four mph with a stern-drive prop. It gets 33 mpg on land, says the maker (ATW Auto-Montan Werke, Buncrana, Eire).



Super prop

Tomorrow's prop plane may match jet speeds, says Lockheed-Georgia Co. about the advanced turboprop concept shown. Smaller, quieter props with thin, sweptback blades spin the engine faster than conventional props. The planes would be fuel-misers, too, says Lockheed.



Grooved collector

This clever corrugated fiberglass collector doubles as a greenhouse roof or wall. Synthetic-rubber water tubes fill alternate spaces in the H_2OTrak panel. Clear spaces admit sunlight. Insolar (200 E. Main, Port Jervis, N.Y. 12771) makes it.

Robot sniffer

Is this driver drunk? A computer will decide. The microprocessor-controlled Breathalyzer 2000 measures the ethanol content of a breath sample passed through an infrared filter. Computer precision means a fairer test, claims Smith & Wesson (Springfield, Mass. 01101).

Push-pull car

Put an extra engine in your trunk—and you don't need a tiger in your tank. With a second GTi engine forward of the spare, this souped-up Jetta has 220 hp—and a choice of front-, rear-, or all-wheel drive. Who needs it? VW's Motorsport team built the prototype for European races.

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What's New IN PHOTOGRAPHY

BY E. H. ORTNER

Elbow sling

Slip your elbow into the sling and press your arm downward with this novel strap system, and neck, elbow, and hands combine to hold your camera steady, says the maker, Holdsteady (Box 253, So. Ozone Park, N.Y. 11420). In leather, it's $20; in webbing, $16; leather strap with web sling, $18.

Locking lens

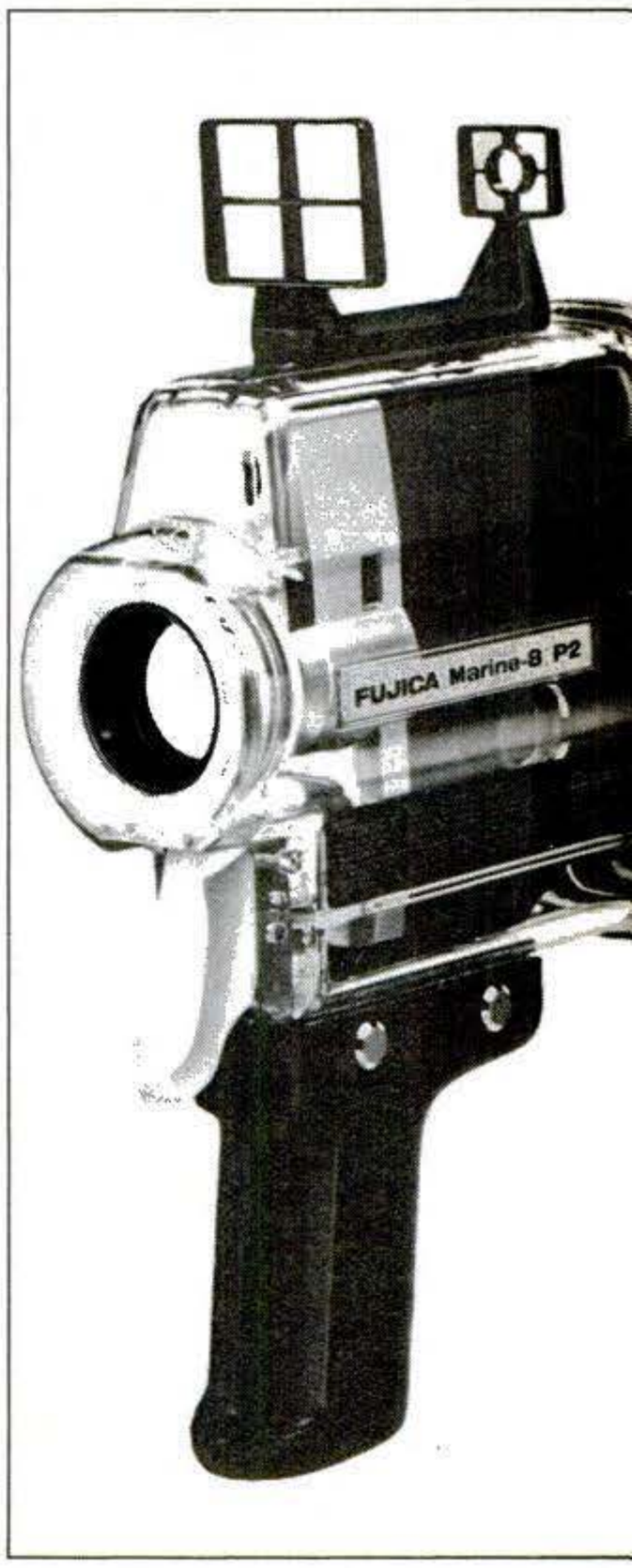
There's no barrel "creep"—slipping of the barrel of a one-touch zoom lens—with the Kiron 70–210 f/4 macro-zoom lens. A switch locks it for focusing. And a non-rotating front lens group lets you use polarizing and other filters without readjustment as you zoom or focus. About $250.

Marine camera

Add a Marine-8 underwater housing and an underwater viewfinder to the Fujica P-2 Single-8 movie camera, and you have an automatic underwater system, good to depths of 100 feet. A large trigger starts the camera going, and exposure through the f/1.8 lens is automatic. The system is $205.

Zoom flash

From a wide-angle 24 mm, the Soligor MK-32A electronic flash can zoom to provide the right light coverage—automatically—for a 200-mm lens at distances up to 82 feet. The thyristorized unit has a guide number of 115 (at ASA 100) and four f-stop ranges. List price: $140.



Panorama head

Want to take 360-degree pictures? Set the Panorama head between your tripod and 35-mm camera. Calibrations indicate degree of rotation needed for successive exposures to make a composite. The head is $18.95 from Spiratone (135-06 Northern Blvd., Flushing, N.Y. 11354).

Waist bag

Three zippered pockets in the Kiwi Waist-Pak hold your gear; an adjustable web belt holds Waist-Pak in place. The padded center pocket is 10 by four by seven inches; the others are seven by four by seven. The bag, made of waterproof nylon, weighs 1¼ pounds, sells for $34.95.

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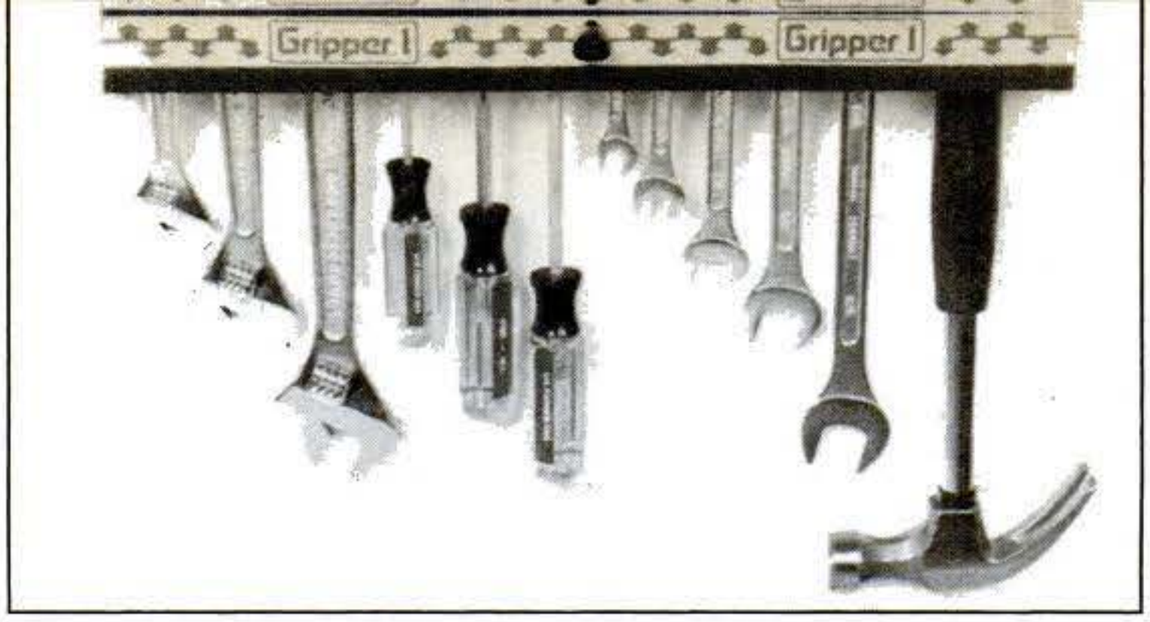
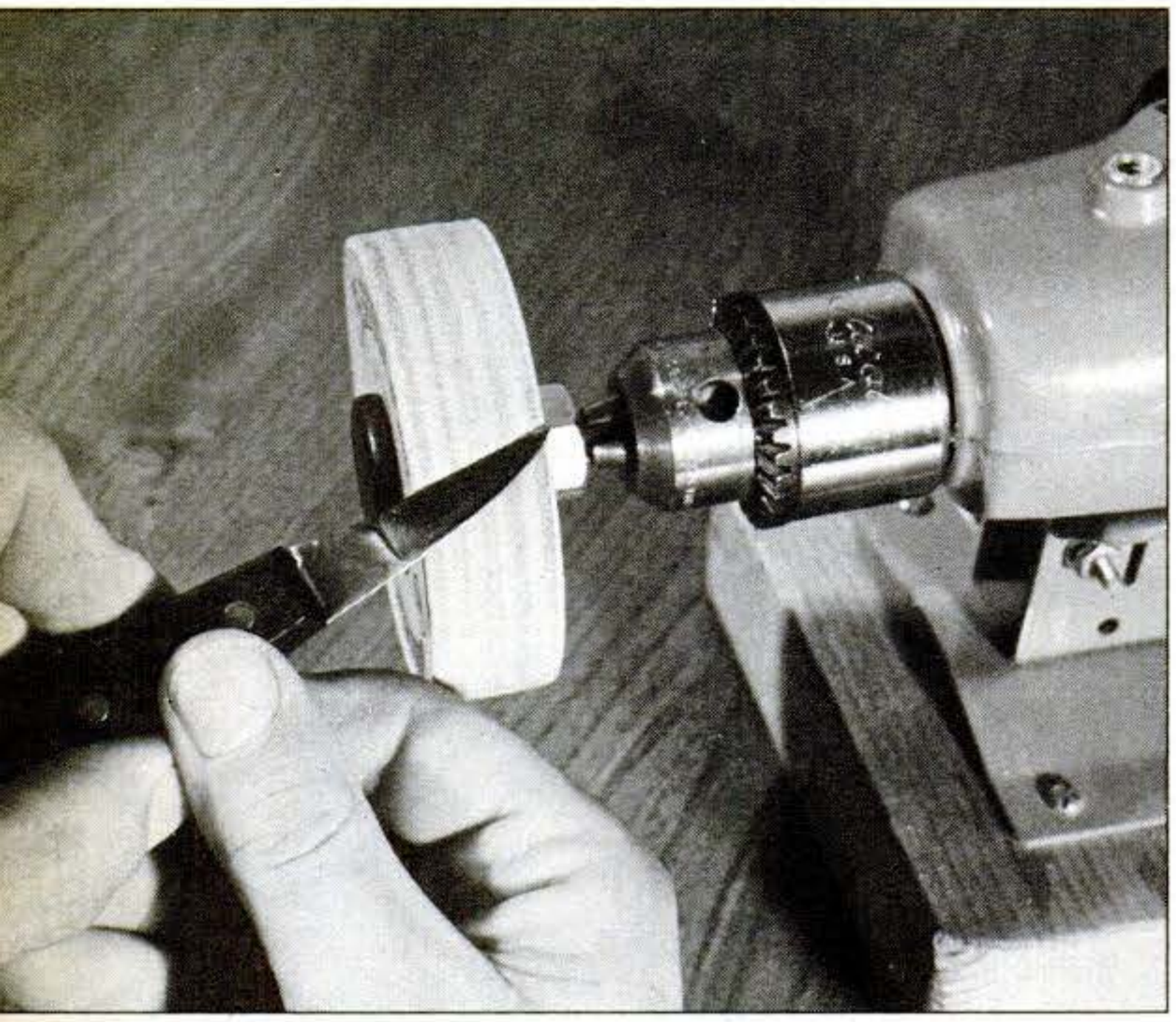
What's New IN TOOLS

BY V. ELAINE SMAY



Hang it all

Gripper 1's flexible rubber fingers firmly hold a wide variety of hand and garden tools, says Pioneer Products, Inc. (666 Sugar Lane, Elyria, Ohio 44035). A tension knob lets you adjust the pressure. The 18-in. hanger is $9.95 (ppd.); the 36-in. model is $18 (ppd.).



Stropping wheel

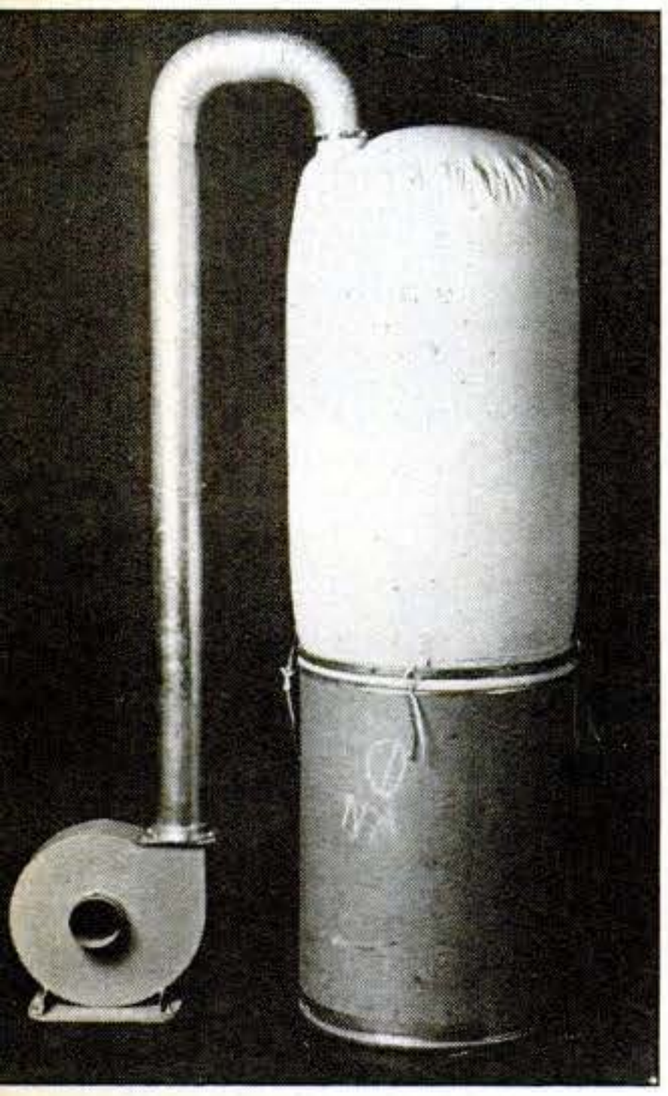
Deburr your stone-sharpened knives and tools to get that final razor edge—it's easy with this leather wheel chucked in your electric drill. Powerstrop (with ¼ lb. of jewelers' rouge) is $10 (ppd.) from Smit Products, Inc., Box 722, Bloomfield Hills, Mich. 48013.

Haul it all

This multi-mode, 400-lb.-capacity Haul In One (Black & Decker, $99) is a cart (as shown), an extended-bed hand truck (with front frame removed), or a standard hand truck (with the extended bed folded and locked against the back frame). In cart mode it can also hold a leaf bag.

Magnetic driver

Screws cling to the bit of Stanley's new Workmaster screwdriver because its aluminum shaft houses a permanent magnet. The magnetic force also holds the bit in place. Five interchangeable bits come with the tool; spares are stored in the handle. Price: $6.85.

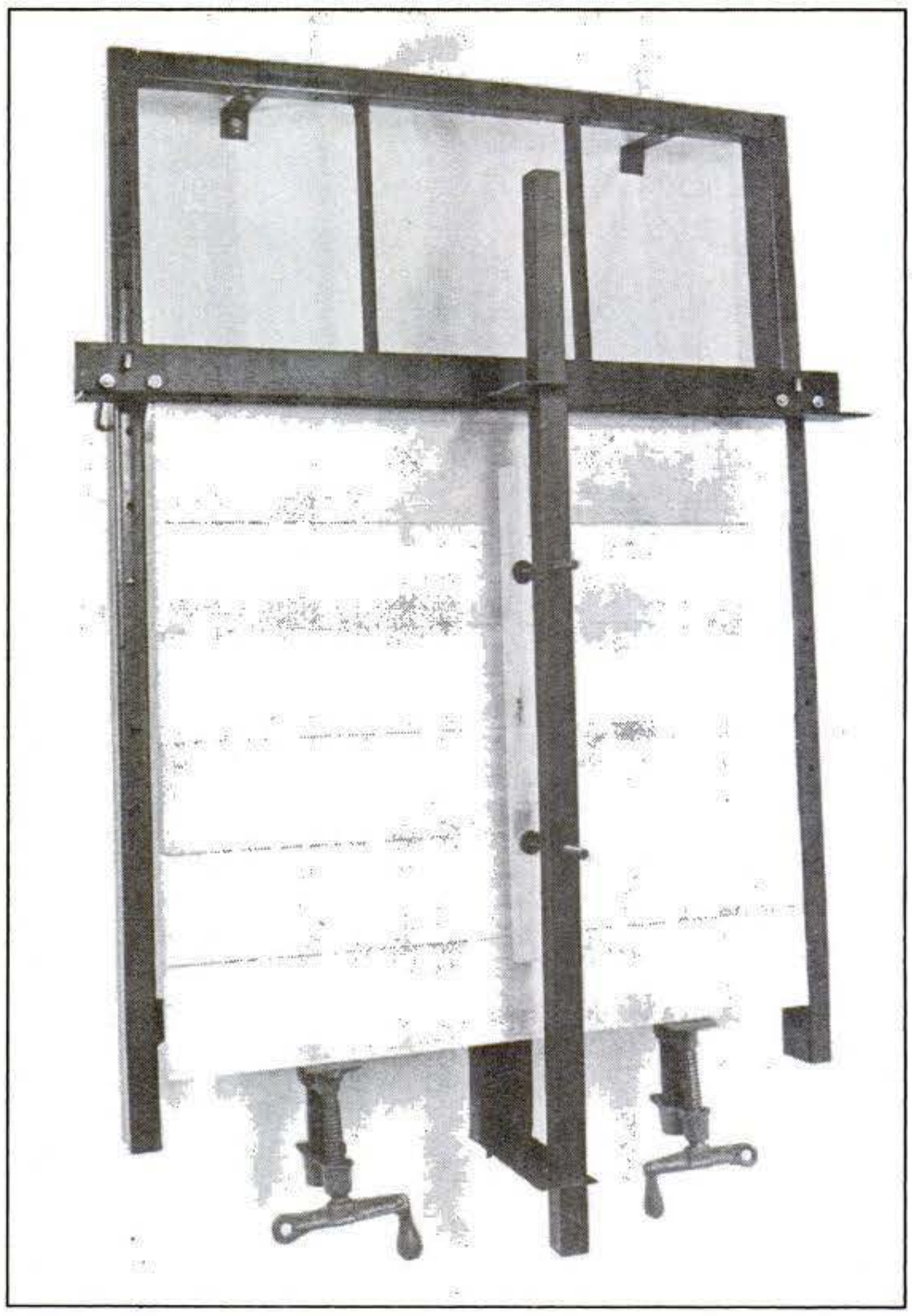


Super vac

Connect the Model 4000 Workshop Waste Collector to your power tools (up to three at a time) and its one-hp motor pulls debris into a giant filter bag and dumps it into a 6.6-cu.-ft. drum. Garrett Wade (161 Ave. of the Americas, New York, N.Y. 10013) sells the system for $698.

Super clamp

You can edge-glue multiple boards with this Adjustable Clamp Bed and your pipe clamps. The top bar applies pressure to keep the boards flat. The whole works hangs on the wall. Price is $49.95 (without clamps). Great Lakes Mfg., 314 Straight S.W., Grand Rapids, Mich. 49503.



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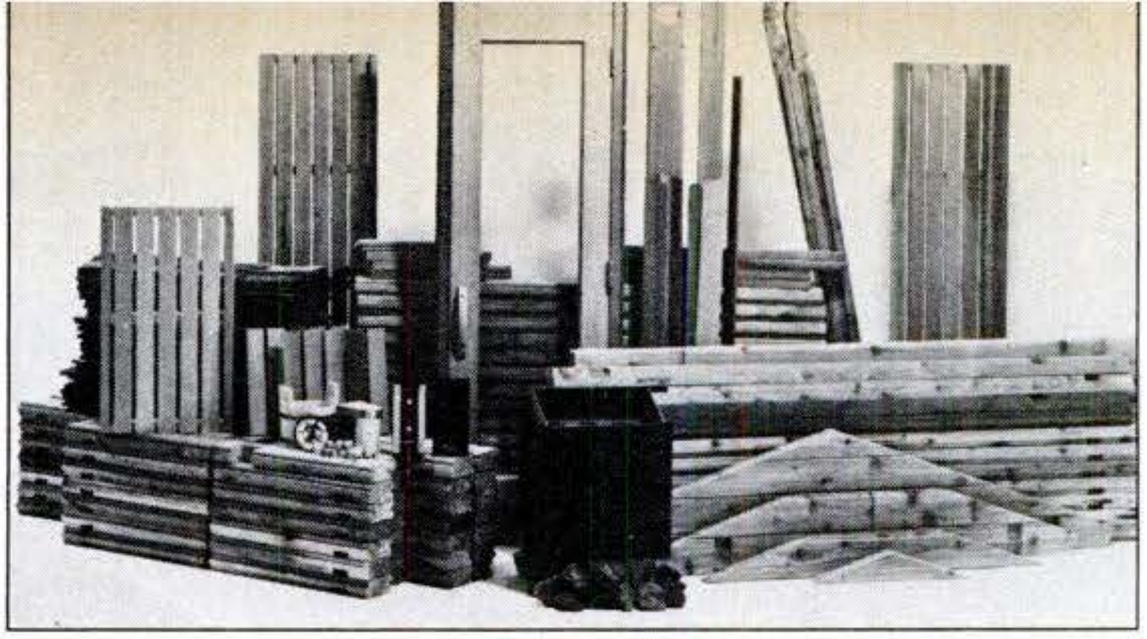
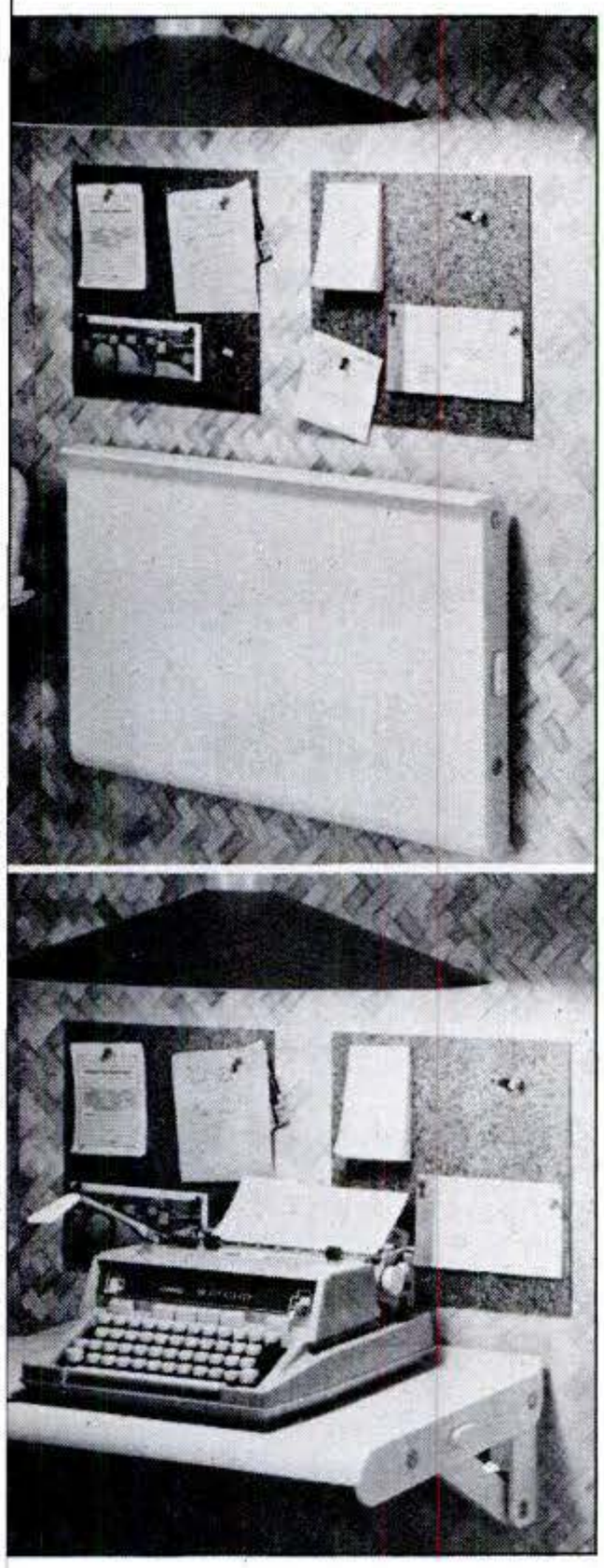
What's New IN HOME IMPROVEMENT

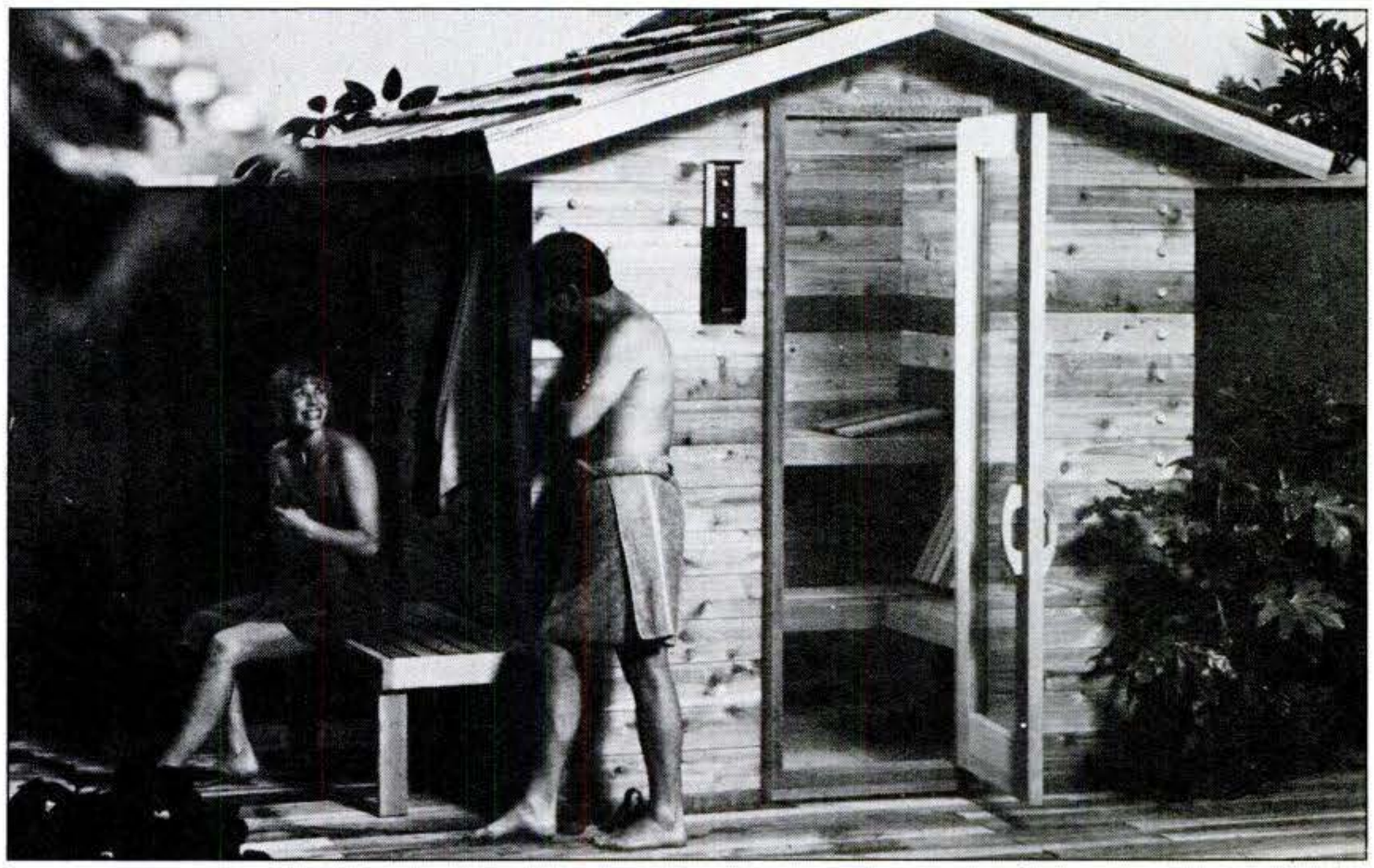
BY SUSAN RENNER-SMITH



Hot kit

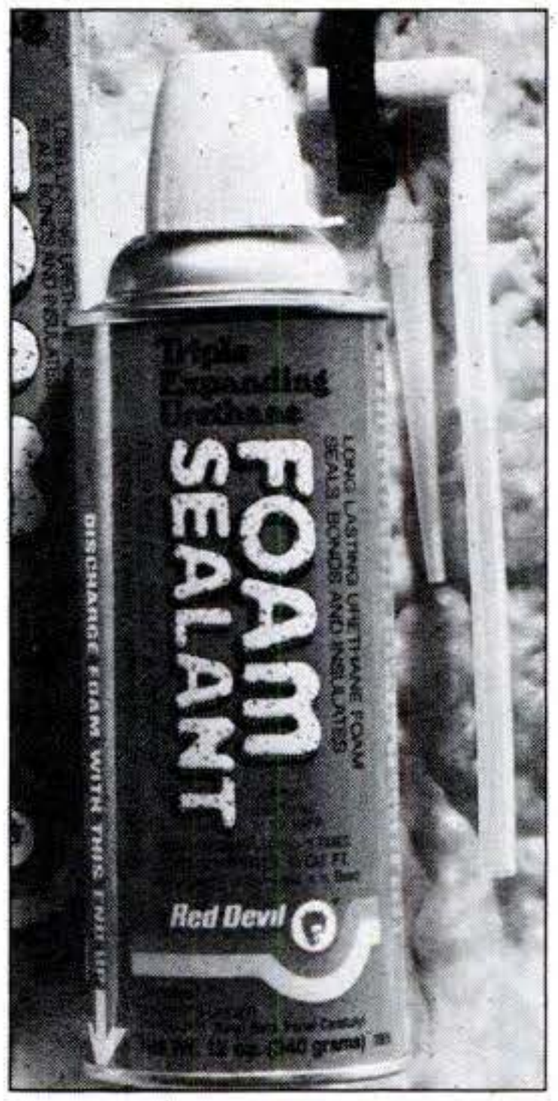
Stacks of precut red cedar (left) assemble into the six-by-eight-ft. outdoor sauna below. The kit includes everything needed for a poolside or patio sauna, including rocks and an electric (240 V) heater. Amerec Corp. (Box 3825, Bellevue, Wash. 98009) sells it for $4,690.





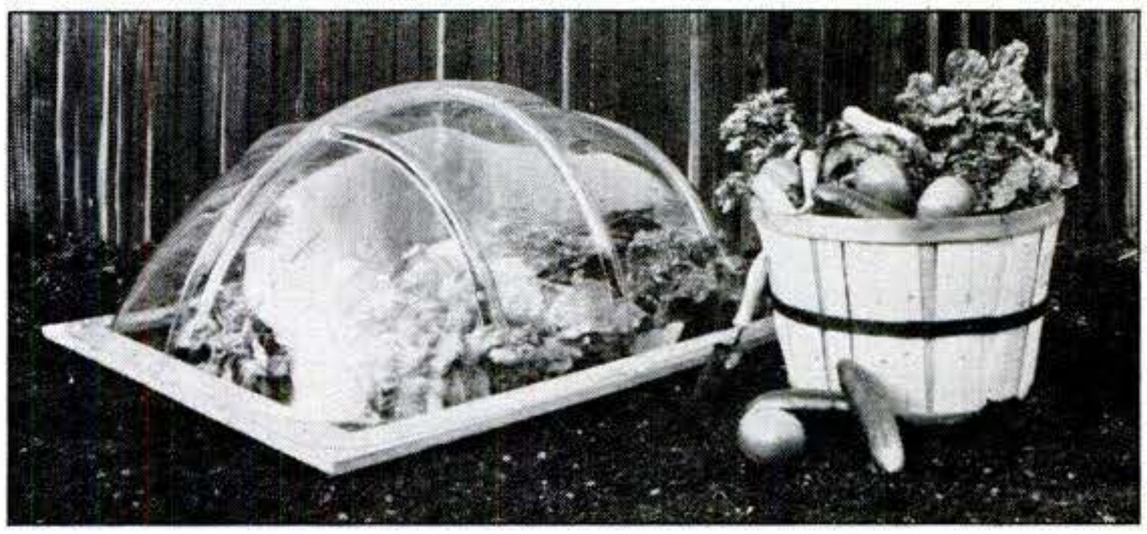
Space saver

Need a home office? The 16-by-24-in. Fold Down Table folds flat when not needed (top), flips up to hold a 40-lb. load (above). The heavy-duty thermoplastic table, made by Syroco (Syracuse, N.Y. 13221), comes in five colors, costs $30.



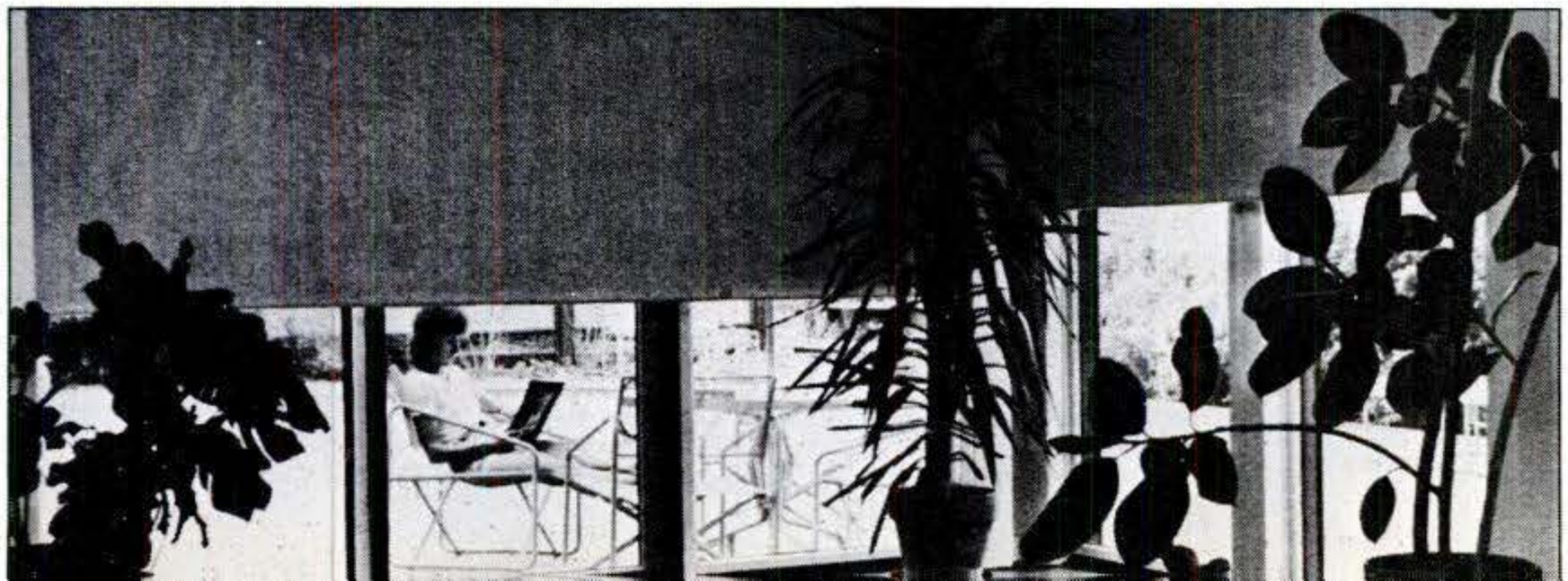
Double-duty foam

It seals air leaks—and it insulates. To do this double job the foam bead expands in minutes to triple its original size. After 24 hours the urethane polymer can be trimmed and painted or plastered. A one-in.-thick bead of Red Devil's new foam sealant has an R-5 rating. $7.



Bubble garden

Pop this plastic dome over a brick-lined ditch—and you can start your garden 30 days before the last frost date, says BQP Industries (4747 Ironton St., Denver, Colo. 80239). The Solar Gro Dome covers about nine sq. ft., is 1½ ft. high. Price: $30.



Heat blocker

Cousin to Curtin Wall [PS, Oct. '79], the two-layer Super Shade insulates sliding glass doors. The burlap-covered reflective shade blocks 85 percent of winter heat loss, says Thermal Technology (Box 682, Broomfield, Colo. 80020). An eight-by-seven-ft. shade costs $333.

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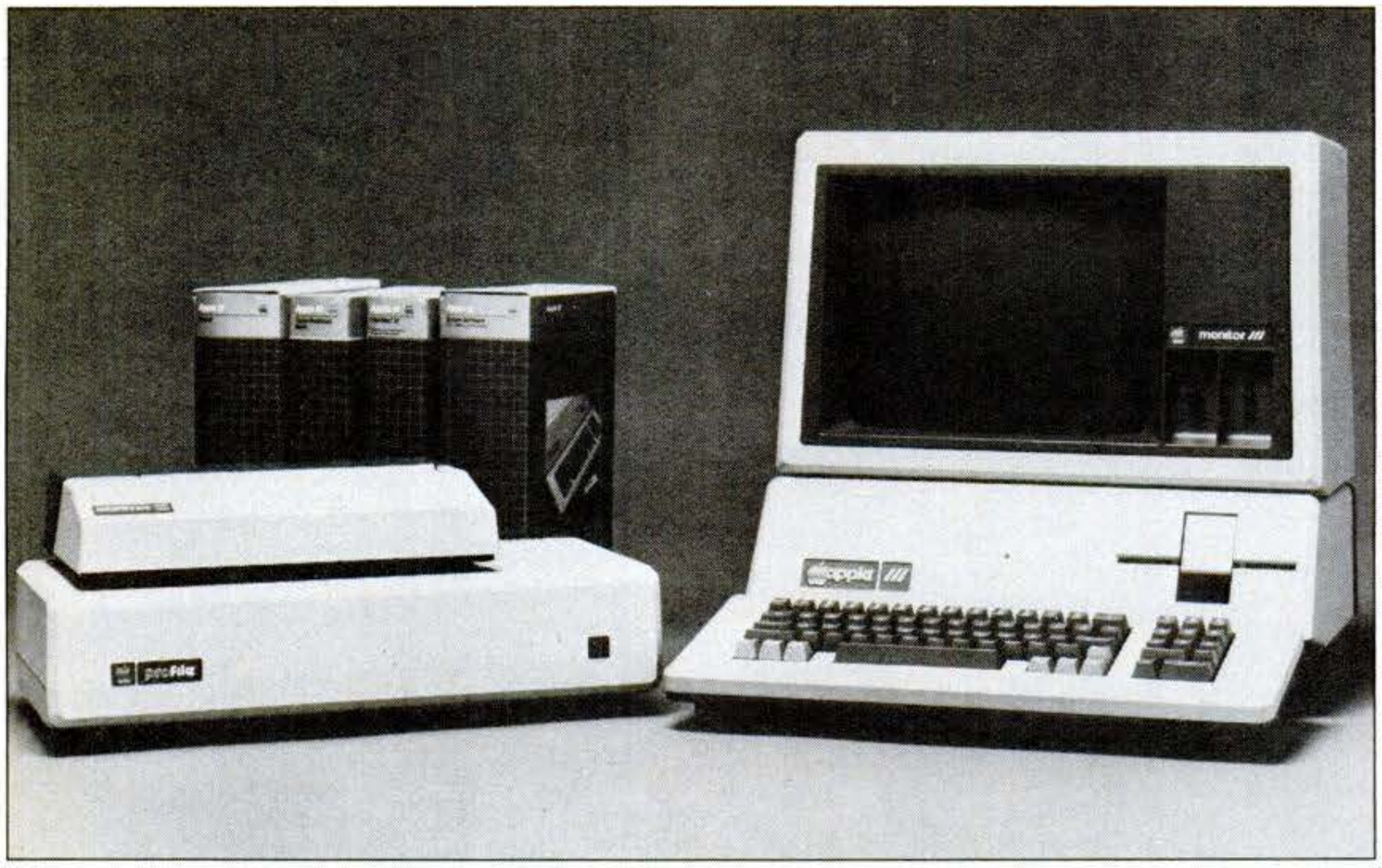
What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS

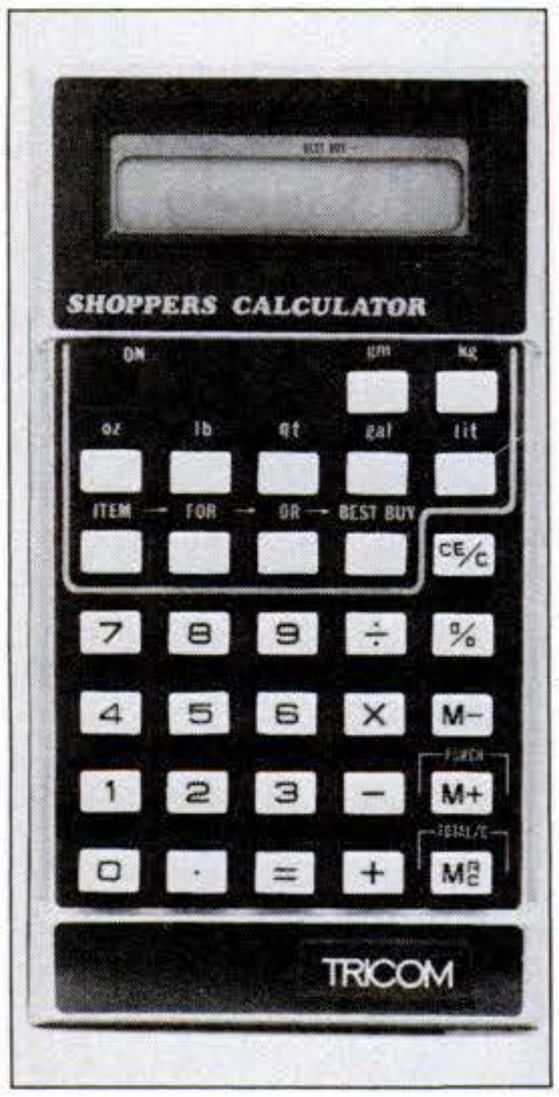
Electronic piano

Play this Casio electronic piano yourself—or accompany a piece entered by light pen from a musical score. (Score must be translated into bar codes.) The player stores up to 345 melody notes and 201 accompaniment chords, plays them back in any of 20 different voices. It's $998.



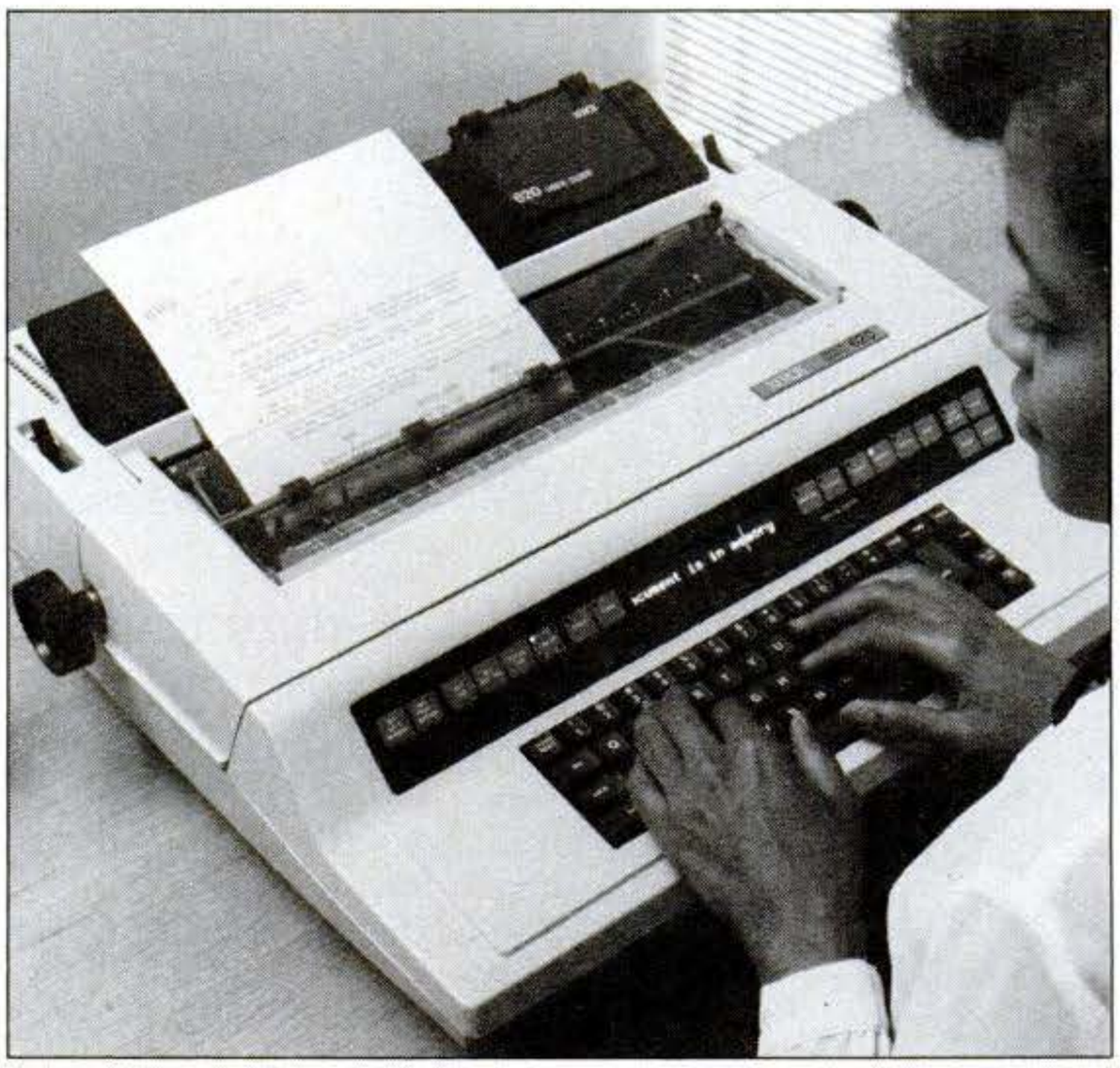
New fruit

Rebuild an Apple III computer with more reliable hardware, throw in a new operating system for control, add a hard-disc system that saves up to five million bytes of data, then offer new software for it. Result: this new Profile system from Apple Computer. Price: $6,994.



Smart typewriter

Memorywriter from Xerox types only the final corrected version of your work. The display shows the material as it's entered. Buttons save or retrieve work or page-layout formats. Centering, indentation, justification, and hyphenation are automatic. Prices start at $1,430.



Shopper's calc

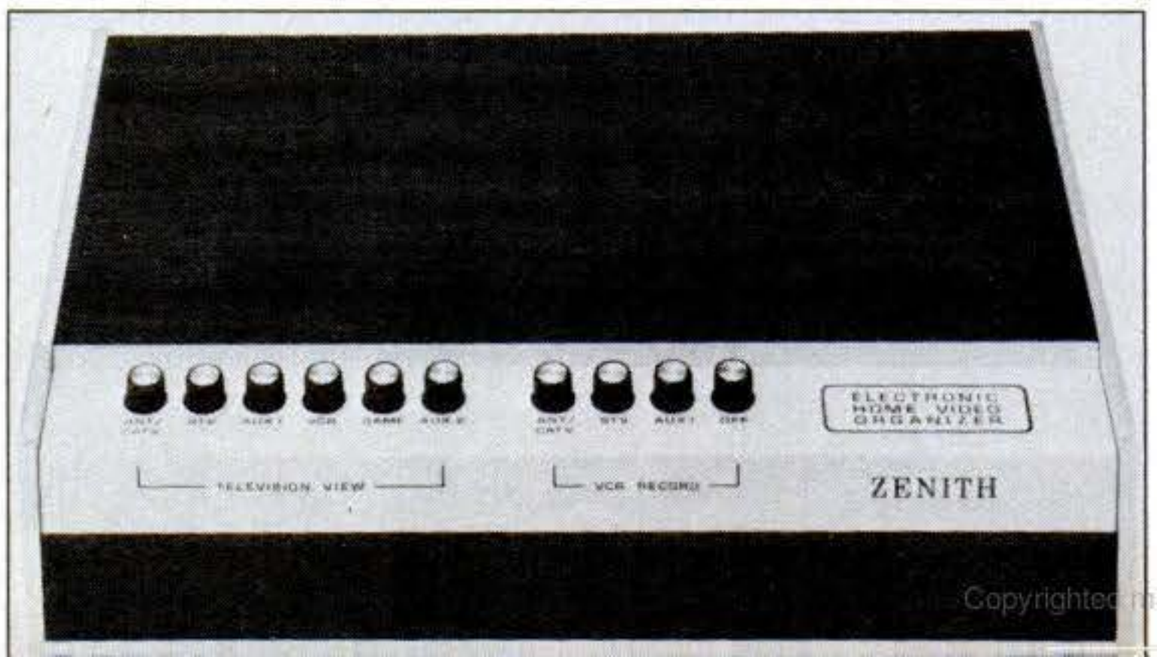
Quick, pick the best buy: three cans of corn at 89¢ or four cans at $1.09? Need help? Try the Shoppers Calculator. Punch in the numbers; it shows the best buy—and keeps a running tab of your bill. $29.95. Tricom, 297 N.W. 23rd St., Miami, Fla. 33127.

Phone helper

Demon Dialer, from Zoom Telephonics (122 Bowdoin St., Boston, Mass. 02108), makes *all* the phones in your home smart. It stores up to 176 numbers and you instantly dial one by using a code word. On busy or unanswered calls, Demon keeps trying and lets you know when it gets through. $200.

Video selector

Connect all your video gear—VCR, cable, antenna, video disc, video game, even your personal computer—to the Organizer from Zenith. You make your selections by just pushing buttons. Six buttons control what you watch; three others determine what's recorded on the VCR. $99.95.



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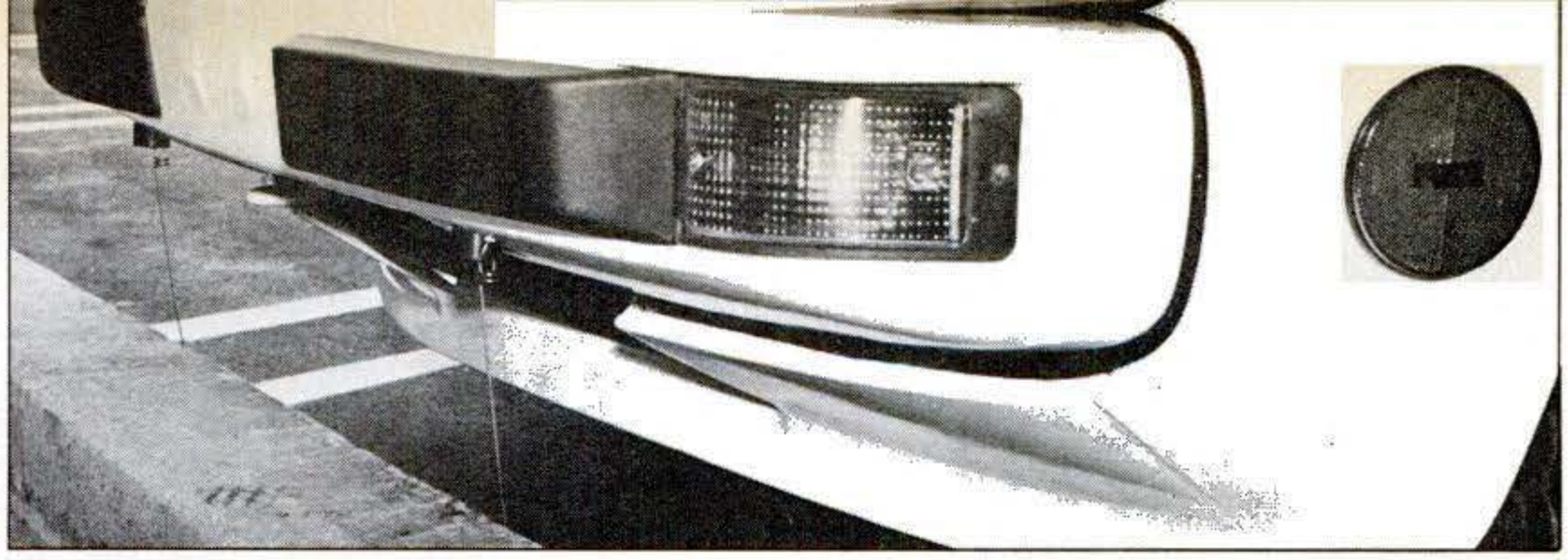
What's New
FOR YOUR CAR

BY ED JACOBS

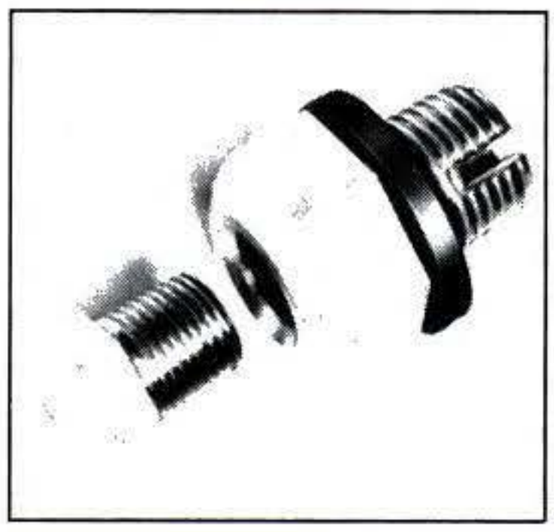


Bed liner/cap

You can use Fliptop as a bed protector (top photo) or flip it over to form a lockable storage canopy. It's about $375 for short-bed Toyota pickups. F.P.S. Co. (543 W. 184th St., Gardena, Calif. 90248) says other models are coming.

Spoiler saver

The feelers hanging from the front bumper of this Porsche 924 automatically sound the ignition-key/seat-belt buzzer when they touch a potentially damaging obstacle, according to Teron Development Co. (Box 10, Woodland Hills, Calif. 91365). Price: $41.50.

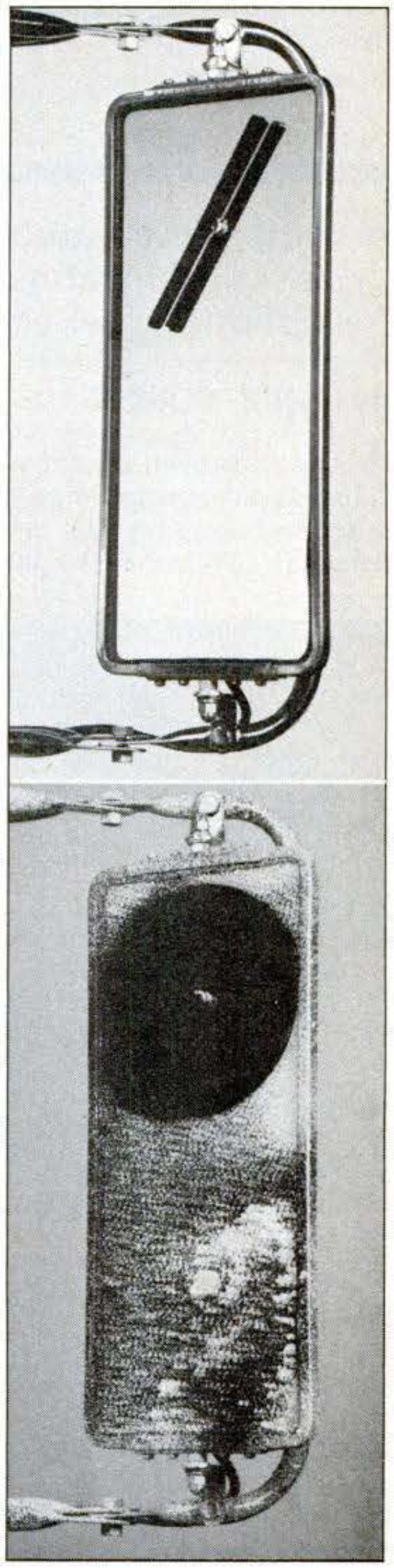


Oil-pan saver

Stripped threads on a crankcase or drain plug? Harvey-Westbury Corp. (81 Urban Ave., Westbury, N.Y. 11590) says that its Easy-Test self-tapping drain-plug kit can repair any damaged half-inch-diameter plug. It costs $2.25, in oversize or double-oversize units.

Weather foiler

All-Weather Mirror has built-in, independently controllable heater and wiper units to defrost and clear the glass of ice, snow, or rain. Clear-View Mirror Corp. (Box 1081, Lima, Ohio 45802) claims it fits most mirror mounts. Price: $114.95.



Digital clock

Want to add a clock to your vehicle? This quartz-regulated LED digital clock can be mounted on or under the dash with double-sided tape, or in the dash with its mounting bezel. Cost: $19.95. Sparkomatic Corp., Milford, Pa. 18337.

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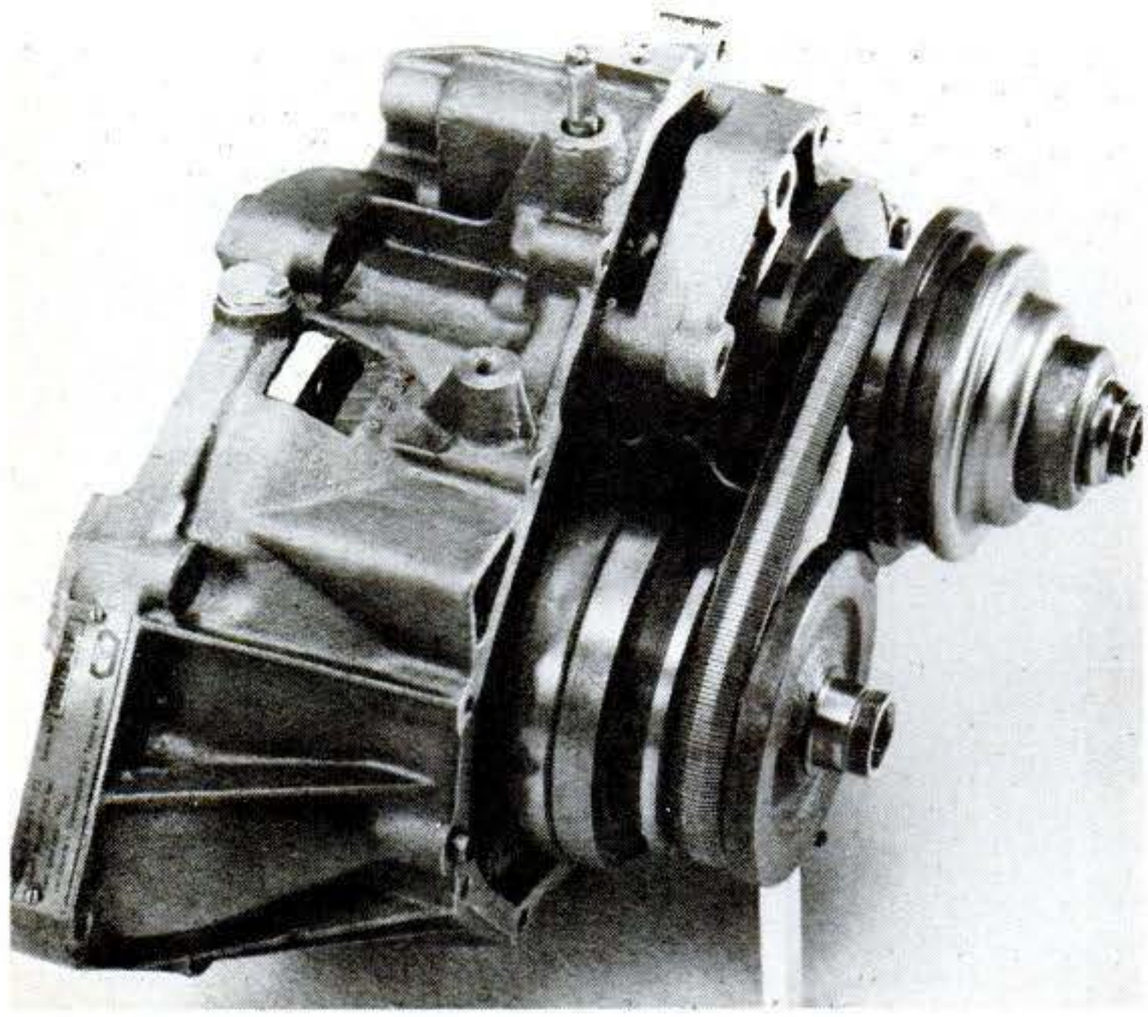
Renault's experimental 57-mpg computer car

A computer controls all drive-train functions for optimum fuel economy

By JAN P. NORBYE

No one—not even an expert driver—can beat a computer at getting maximum fuel economy. All drivers have personal driving styles and habits that waste fuel. The computer, however, sticks tenaciously to its program to deliver maximum economy.

That's why Renault has put a computer in its prototype car to control the variables—throttle opening, air-fuel ratio, ignition timing, and even transmission ratios. This feat is accomplished with a microprocessor, an array of specialized sensors, an electronically controlled carburetor, and a continuously variable automatic transmission. Basically, the driver just steers and tells the car how fast to go.



Renault EVE is a running, functioning car, unlike the hollow shells that most design exercises and show cars are. None of the features, design elements, or materials used in EVE is so exotic that Renault couldn't use it on production cars within a decade. A key to the car's high fuel economy is the continuously variable Van Doorne Transmatic automatic transmission, shown here with a cover removed.

The prototype is called EVE (economical vehicle elements), and its design goal was a near-term car that would offer the roominess, comfort, cargo capacity, and performance of a Renault 18, yet deliver 35 percent better highway fuel economy and 24 percent more in the city.

The importance of the sophisticated electronics was spelled out by research and development director Pierre Tiberghien: "Electronics must play a role at the moment a car is conceived. Therefore, we create interdisciplinary teams where the engine designer and electronics specialist work together on the job."

Right now, EVE uses a production-based four-cylinder aluminum engine. Future cars may have three-cylinder versions for gasoline, gasohol, and, finally, pure alcohol. Later, there may be a stratified-charge multi-fuel two-stroke using direct injection, two spark plugs per cylinder, and a lubrication system that would meter precise amounts of powdered synthetic oil to the cylinder walls.

EVE's two-barrel carburetor has no throttle linkage. A transducer on the accelerator pedal sends signals to the microprocessor, which integrates them with other sensor data to set the correct throttle opening.

EVE uses the continuously variable Van Doorne Transmatic automatic transmission [PS, June '80]. Its ratio selection is also computer controlled, through hydraulic servos. The ratios are closely controlled to keep the engine in a narrow rpm band, where it burns fuel most efficiently.

The front-wheel-drive EVE is built on the Renault 18's 96-inch wheelbase and floor pan, but weighs about 220 pounds less because much aluminum has been substituted for steel.

Putting a truly aerodynamic shape on a car of the R18's wheelbase wasn't easy. After considerable refinement, however, designers arrived at a drag coefficient of just 0.239—more than a 35 percent reduction from the R18, which translates into greatly improved fuel economy. EVE is rated at 57.3 mpg at a steady 56 mph, 42.7 mpg at 74.5 mph, and 35.6 mpg on the European urban driving cycle.

The next steps will include further weight reduction, a diesel engine with direct fuel injection, and continued mechanical-efficiency improvements. In the meantime, lessons learned in space efficiency and aerodynamics are already finding their way into production cars. PS

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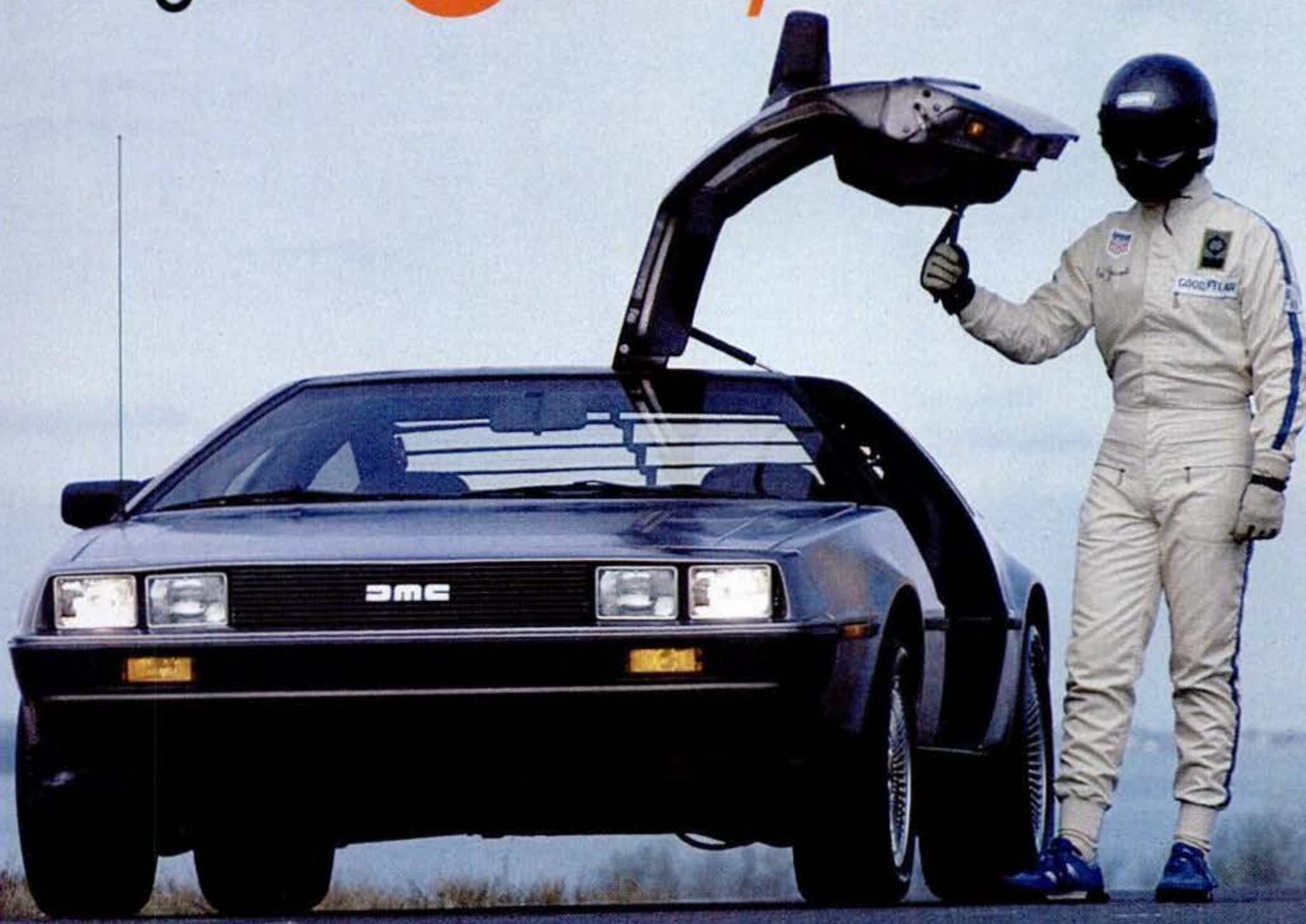
Imported Cars/1982

Popular Science



SPECIAL SECTION

Imported cars continue to grow in popularity with American buyers. Last year, they captured 25 percent of the U.S. market. This year, despite staggering interest rates, an almost disastrously depressed new-car market in America, and voluntary export restrictions by the Japanese auto manufacturers, import sales soared past 30 percent.

This year, we concentrate our attention on the more popular imports, those with base prices below $15,000. The one exception is the sleek, stainless-steel-skinned De Lorean you see above. The first East Coast track test of this attention-grabbing sports car leads off this 12-page special section on imported cars/1982. Following that test are articles covering what's new among economy and mid-price imported models. Finally, we present an exclusive full track test of six fuel-pinching imports rated at 50 mpg or more on the EPA highway test—three diesels and three gasoline-powered models.

—The Editors

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How the Pickup works: The front-wheel drive train.

Nothing else is a Volkswagen.

When man first hooked up horses to plows and carts, he quickly discovered that pulling things was a lot easier than pushing them.

Yet after centuries of transportation, VW was the first to use a front-wheel drive train on a pickup truck.

By pulling its load instead of pushing it, the VW Pickup can pull its weight more easily than equivalent trucks with rear-wheel drive. Up to half a ton. And, don't worry about what you carry. Its double-walled construction can handle anything you throw into it.

The VW Pickup has certain other advantages. Namely, excellent traction and exceptional directional control. The pickup also comes with VW's unique upshift light which tells you exactly when to shift for optimum mileage.

And, when hooked up to VW's famous diesel horse, you can enjoy the best mil age to be found on a pickup, anywhere

EPA 49 mpg highway estimate, and an estimated 42 mpg. (Use "estimated mpg" for comparisons. Your mileage may vary with weather, speed, and trip length. Actual highway mileage will probably be less.)

And that ain't hay.

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DE LOREAN

Space capsule for the road

By JIM DUNNE and ED JACOBS

John Z. De Lorean's radically new sports car is built in a brand-new plant in a country where cars have never been a major product in the past. In an assembly operation where some 20,000 separate parts must come together neatly, that combination could spell disaster.

How does the De Lorean stack up as a quality package? Aside from an initial problem with the gearshift linkage and a water leak behind the passenger's head, we found a high level of fit and finish and mechanical balance throughout the body and chassis of our test vehicle. (For some initial impressions, see our July '81 report.)

What's it like to drive this dramatically different car? To begin with, *unusual* is just not a strong enough word to describe the two-seater. Think of a space capsule, and you come closer to the feeling you get when you're inside. The strut-assisted gull-wing doors close like a bank vault's, and you sit in seats reclined so low that you can't see the car's four corners. Around you, almost everything is heavily padded. The hump formed by the car's center spine is extra high, and rises to a point about even with the driver's elbow, well above normal height in other cars. (The spine doesn't house the drive shaft, this being a rear-engine car, but adds body rigidity.)

All of this takes some getting used to; if you're not familiar with it, the De Lorean isn't the sort of car you can just jump into and drive.

[Continued on page 134]

PS ratings—test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

Acceleration	5
Braking	2
Handling	4
Maneuverability	5
Quietness	1
Roominess	0†
Vision	0
Entry/exit ease	0
EPA economy	3
Ride comfort*	2

*Authors' opinion
†No rear seat

De Lorean—dimensions, specs, and test results

DIMENSIONS (inches)

Wheelbase	94.8
Overall length	168.0
Overall height	44.8
Overall width	78.3
Track, F/R	62.6/62.5
Ground clearance	5.6
Front head room	34.5
Front hip room	40.0
Front leg room	44.5

SPECIFICATIONS

Engine type	SOHC V6
Displacement (cu. in./L)	174/2.9
Compression ratio	8.8:1
Carburetion	F.I.
Net hp @ rpm	130 @ 5500
Net torque @ rpm	153 @ 2750
Transmission	Five-speed manual
Axle ratio	3.44:1
Tire make	Goodyear
Tire type	NCT HR60 steel-belted radial
Tire size, front	195/60HR14
Tire size, rear	235/60HR15
Steering	Rack and pinion, manual
Overall steering ratio	n.a.
Turns, lock to lock	2.4
Turn diameter (ft.)	42.0
Front suspension	Independent, unequal-length control arms, coil springs
Rear suspension	Independent, trailing arms, upper and lower control arms, coil springs
Front stabilizer-bar diameter (in.)	0.75
Rear stabilizer-bar diameter (in.)	None
Brakes	Disc/disc, power
Brake swept area (sq. in.)	541.0
Fuel tank (gal.)	13.5
Trunk space (cu. ft.)	14.0
Liftover height (in.)	27.5
Curb weight (lbs.)	2743
F/R weight distribution (%)	37/63
Basic price	$25,000
Price as tested	$25,000
Major options on test car	None

TEST RESULTS

Acceleration (sec.)	
0-60 mph	10.5
25-70 mph	11.7
Brake test (cool) 60-0 mph	
Stopping distance (ft.)	149
Pedal pressure (lbs.)	75
Brake test (hot) 60-0 mph	
Stopping distance (ft.)	182
Pedal pressure (lbs.)	175
Interior noise @ 60 mph (dBA)	72
Handling test (mph)	62.4
Maneuverability test (mph)	27.6+

TEST CONDITIONS: Ambient temperature, 55°F; relative humidity, 75 percent; barometric pressure, 29.96 inches Hg

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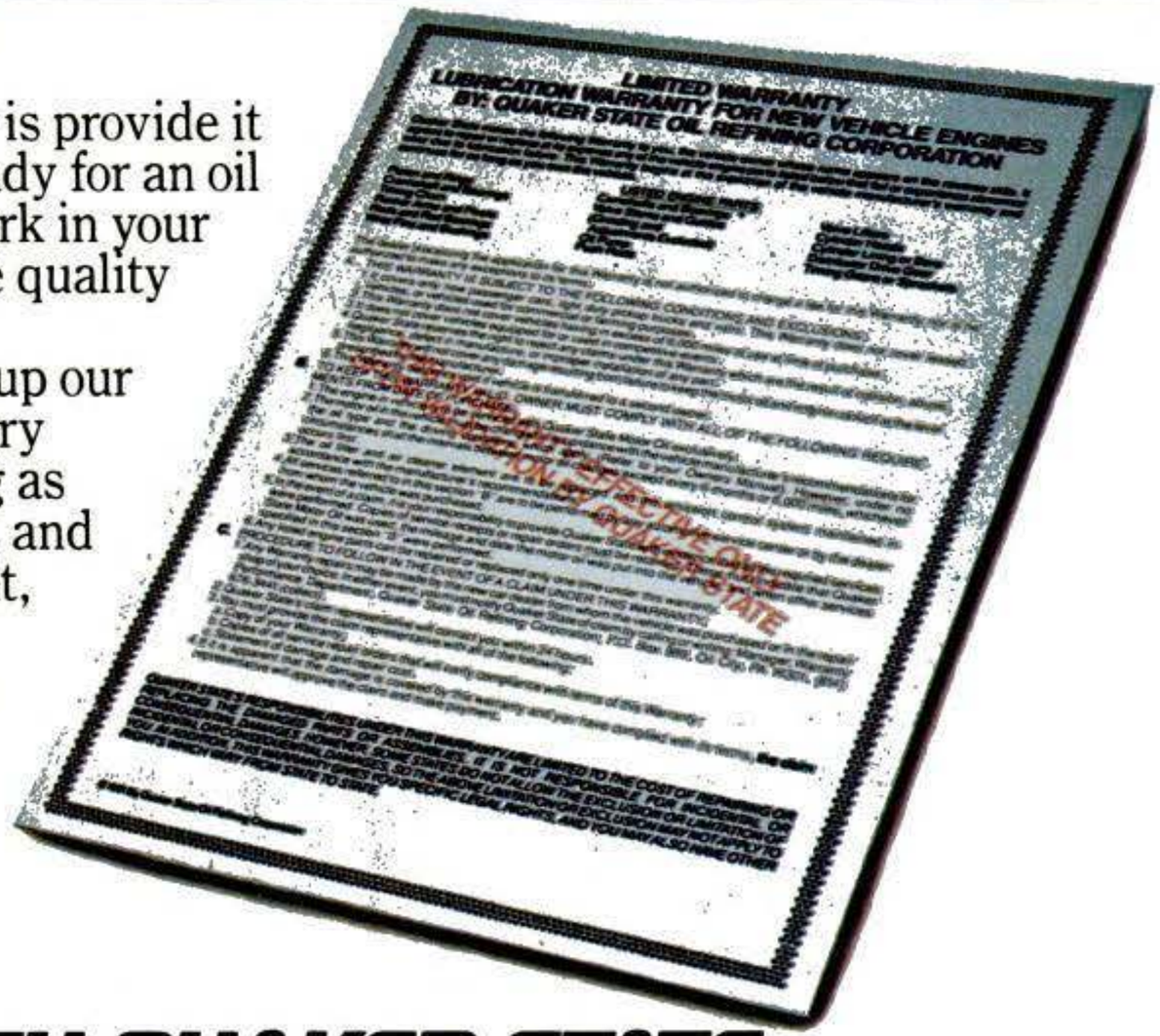
HOW DO YOU KNOW HOW GOOD YOUR MOTOR OIL IS?

"AT QUAKER STATE, WE PUT IT IN WRITING."
Quentin E. Wood
President

Probably the biggest favor you can do your car is provide it with clean, fresh, *quality* motor oil each time it's ready for an oil change. But, since you can't watch a motor oil at work in your car's engine, how do you know you're getting all the quality you've paid for?

At Quaker State, we put it in writing. We back up our quality with a *lifetime* guarantee. We guarantee every new car engine against oil-related failure for as long as you own your car and use Quaker State. For details, and coverage, write Quaker State, Warranty Department, Oil City, PA 16301.

And you don't have to buy a new car to benefit from Quaker State quality. When you put Quaker State in your car—old or new—you're putting in America's quality motor oil. Made only from Pennsylvania Grade Crude Oil.



STAYIN' ON THE ROAD WITH QUAKER STATE

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50-mpg imports

How do they compare?

By JIM DUNNE and ED JACOBS
PHOTOGRAPHS BY JOHN KEATING

To qualify for our imported economy-car test last February, a car had to be rated at 40 mpg or higher on the EPA highway cycle. But this year several models have highway ratings above 50 mpg. We picked six—the mileage leaders from their respective manufacturers—for this test.

Three are gasoline powered: Dodge Colt, Honda Civic FE, and Toyota Starlet. The others are diesels: Audi 4000, Isuzu I-Mark, and Volkswagen Jetta. (Datsun isn't represented here because the 210 is out of production and its replacement wasn't available in time to test.)

All six cars gave excellent fuel economy, but none came close to its EPA highway rating. Most were hobbled by having only a few miles on their drive trains and could be expected to deliver better economy once properly broken in.

Here's a closer look at our six miserly imports.

Audi 4000 Diesel

The Audi 4000 is a cousin of the Volkswagen Jetta—also in this test—but the relationship isn't too close. They share the same engines, but the bodies, the rest of the drive train, and even the drive-train orientation are different.

Inside, the Audi has more space than the others, with plenty of room for four. The interior is finely finished, and the firm front seats are well formed to hold you in place.

If you've already checked the test-result tables, you may be as stunned as we were at the Audi's poor acceleration. However, after testing was completed Porsche+Audi service technicians found a maladjusted throttle cable, which prevented full fuel-injection enrichment. Ordinarily, allowing for weight and gearing differences, we'd expect the Audi and Jetta to have comparable acceleration. (Note: The Audi's fuel-economy performance would *not* have been affected by the cable problem.)

Dodge Colt

It's no secret that American auto makers are looking closely at Colt when they consider future car designs. The Mitsubishi-built Colt (and its identical Plymouth twin, Champ) was one of the first modern basic-transportation cars. It still stands out as one of the best.

Simplicity is the key word, and the box-with-a-wheel-at-each-corner layout yields a hatchback that can give you about all you'd want in versatility, economy, and agility.

In a car this small, however, something generally has to give. In the Colt's case it's rear-seat room. Adults sit on thinly padded cushions with their knees pressed against the backs of the front seats.

Colt's standard four-speed manual transmission has higher EPA ratings than the fancy, optional, dual-range Twin Stick unit we tested last year, because the EPA tests the Twin Stick in both the power and economy ranges and averages the two. While some people may benefit from the dual-range transmission, most drivers will be well served by the simpler four-speed.

Honda Civic FE

Honda has always been known as an economy leader, but there's more to this front-drive than just basic transportation and EPA's highest gasoline-power ratings. The interior is attractive and nicely finished, and the instruments (which even include a tachometer) are simple and easy to read.

The lightweight chassis has the feel

Continued

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Audi 4000 Diesel	Dodge Colt	Honda Civic FE	Isuzu I-Mark Diesel	Toyota Starlet	Volkswagen Jetta Diesel
Acceleration	0	2	3	0	1	0
Braking	2	3	2	2	1	2
Handling	3	3	3	2	3	2
Maneuverability	5	5	5	5	5	5
Quietness	0	0	0	0	0	0
Roominess	3	3	2	2	2	3
Vision	5	5	5	4	5	4
Entry-exit ease	3	3	3	2	2	3
EPA economy	5	5	5	5	5	5
Ride comfort*	3	2	2	2	2	3

*Authors' opinion

EPA fuel mileage (mpg)

	Audi 4000 Diesel	Dodge Colt	Honda Civic FE	Isuzu I-Mark Diesel	Toyota Starlet	Volkswagen Jetta Diesel
Highway	52	51	55	51	52	59
City	38	39	41	41	38	43
Calif. city	38	38	39	41	37	43

PS fuel-mileage tests
(steady-state mpg)

35 mph	62.6	56.5	64.7	63.9	64.7	74.2
55 mph	44.0	38.9	41.9	43.5	40.7	47.5

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Our three gas-powered challengers, gathered on the lane-change grid (front to rear): Toyota Starlet, Dodge Colt, Honda Civic FE.

of a heavier car, solid and secure at highway speeds with little wander in crosswinds. What's more, careful gear-ratio selection not only nabbed the Civic FE the top economy spot in our gasoline-powered group but also made it the quickest in the test.

Like the Colt, Honda's small exterior dimensions and large hatchback combine for great versatility.

Isuzu I-Mark Diesel

Isuzu isn't really a new name here. When GM stopped importing cars from its German subsidiary, Opel, it began importing the Isuzu Gemini—sold from 1976 to 1980 as the Buick Opel by Isuzu. Now Isuzu has set up its own U.S. operation and is importing the car as the I-Mark.

Since GM owns 34.2 percent of Isuzu, it shouldn't be surprising to learn that I-Mark's diesel is used in the Chevette [PS, Feb.]. That engine is one of I-Mark's pluses. It starts after only a four-second wait on 30-degree-F mornings and is pretty quiet after it warms up. And it's not objectionably loud at highway speeds.

Because of the old-style front-engine-rear-drive configuration, the I-Mark's interior room is limited by the big transmission hump and driveshaft tunnel. The all-or-nothing heater controls won't help your comfort much, either. They'd rather give you full heat or full fresh air.

Toyota Starlet

Starlet is Toyota's fuel-economy leader but—surprisingly—isn't the lowest-priced Toyota; the larger Corolla Tercel is.

Like the Isuzu, the front-engine-rear-drive Starlet loses valuable floor space to the drive train. And although there is a colorful instrument panel, the rest of the cockpit is plain.

But fuel economy is Starlet's specialty. To that end, you get a mild-mannered 1.3-liter four-cylinder engine, five-speed overdrive transmission, and a low 1,725-lb. curb weight. Even with a tight new engine, our Starlet delivered better than 40 mpg at a steady 55 mph.

Unfortunately, economy comes at the expense of acceleration. Starlet was the slowest of the gasoline-powered cars by a wide margin. Equally unfortunate, the sluggish acceleration is coupled with weak brakes.

Volkswagen Jetta Diesel

Jetta, like the I-Mark and Starlet, is in its second year here. And it's still as

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The diesel-powered contenders, aligned in the low-speed slalom site (front to rear): VW Jetta, Isuzu I-Mark, and Audi 4000.

well thought out and finished. The front seats are thickly padded and shaped to hold you in place. And the rear seats are set up for just two passengers, so there's no uncomfortable crowding.

While Jetta is sometimes called a sporty car, there is little feeling of sportiness in the hard-worked diesel version other than its nimble handling. And what do you get when you take away a sporty car's performance? In Jetta's case, a comfortable, nicely made—but slow and noisy—four-seater. Engine noise isn't a problem on the road, though.

Like all manual-transmission Volkswagen products, Jetta has the upshift indicator light, which tells you when to shift to the next higher gear for better economy without losing engine power. Some might find it distracting, but not those interested in maximum economy.

Our picks:

I'm most impressed by the simplicity of the Dodge Colt—that plus the performance. It's easy to picture Colt as a household car, one that anybody would like to drive on short-trip errands. Yet it will cruise comfortably on highway jaunts. The hatchback completes the picture, turning this fuel miser into a utility car with carrying capacity close to that of a station wagon.—J. D.

I still won't trade good brakes or handling for fuel economy, and all these cars need better brakes. Most could use more power, as well. Those

Continued

Performance comparison with selected models

	Mpg (city driving)	Acceleration 0-60 mph (sec.)	Brakes 60-0 mph (hot) (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60 mph (dBA)
1981 Dodge Colt 4	33	15.3	163	65.0+	27.6+	70
1981 Honda Civic 4	35	13.6	177	61.0	27.6+	75
1981 Toyota Starlet 4	39	18.1	172	60.2	27.6+	73
1981 Volkswagen Jetta 4	26	14.8	186	62.8	27.6+	74
1982 Volkswagen Rabbit Diesel 4	43	27.7	163	58.3	27.6+	73
1982 Ford Escort 4	31	16.2	181	60.5	27.6+	74

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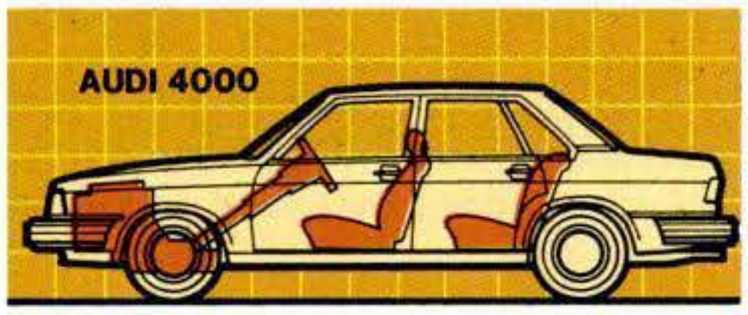
points aside, the Dodge and Honda seem to be the most practical choices. Among the diesels, the Isuzu has the best around-town responsiveness, but it lacks the roominess and comforts of the other diesels.—E. J.

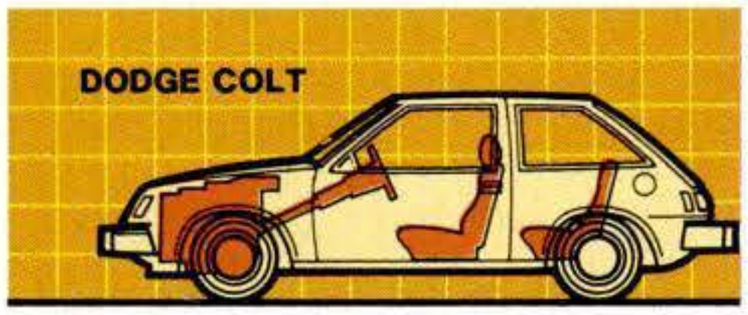
PS serviceability ratings

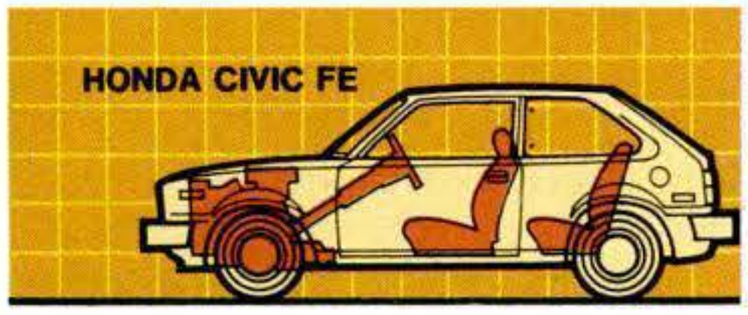
How easy is it to service these cars? To give you an approximation of how difficult it is for a typical person to perform various service operations, we examine each test vehicle. The numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty; 4, easy; 5, very easy.

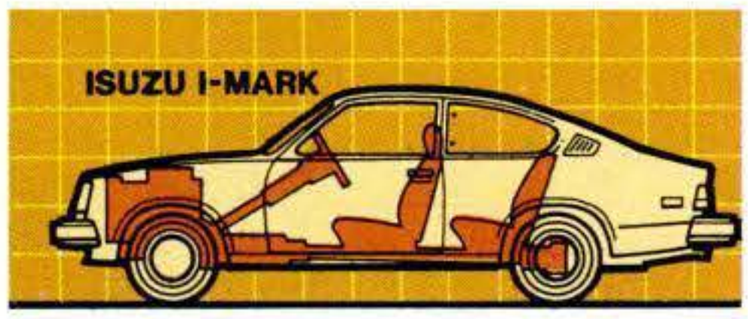
	4000 Diesel	Colt	Civic	I-Mark Diesel	Starlet	Jetta Diesel
Checking fluid levels						
Battery	5	4	5	5	5	5
Master cylinder	5	5	5	5	4	5
Windshield washer	5	5	5	5	5	5
Engine oil	3	3	3	2	3	2
Coolant	5	5	5	3	5	5
Checking the engine						
Spark plugs	n.a.	4	4	n.a.	4	n.a.
Distributor	n.a.	4	4	n.a.	4	n.a.
Carb adjustment	F.I.	*	*	F.I.	*	F.I.
Oil filter	4	2	3	2	3	3
Oil fill	3	3	2	2	2	2
Replacing hoses						
Upper radiator hose	5	4	5	5	5	5
Lower radiator hose	5	3	1	2	4	3
Heater hoses	1	1	3	2	3	1
Changing bulbs						
Headlights	3	2	3	3	3	3
Taillights	3	3	3	3	1	3
Front running lights	3	3	3	3	3	4
Front parking lights	3	3	3	3	3	4
Front directionals	3	3	3	3	3	4
Rear directionals	3	3	3	3	1	3
Rear running lights	3	3	3	3	3	3
Checking fuses	4	4	4	4	4	4
Spare-tire accessibility	4	4	4	4	4	3
Changing belts	1	4	4	3	3	1

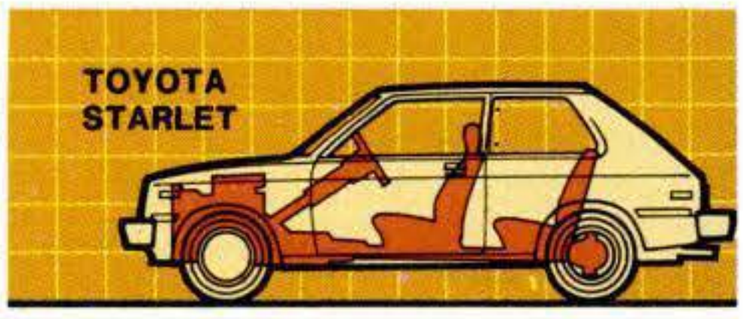
*Sealed

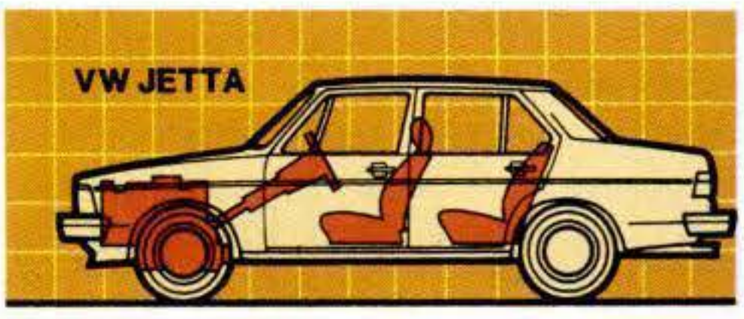












DRAWINGS BY RUSSELL VON SAUERS

Audi 4000 Diesel, Dodge Colt, Honda Civic FE, Isuzu I-Mark Diesel, Toyota Starlet, and Volkswagen Jetta Diesel—dimensions, specs, test results

DIMENSIONS (inches)	Audi 4000 Diesel	Dodge Colt	Honda Civic FE	Isuzu I-Mark Diesel	Toyota Starlet	Volkswagen Jetta Diesel
Wheelbase	99.5	90.6	88.6	94.3	90.6	94.5
Overall length	176.7	157.0	148.4	170.1	152.2	167.8
Overall height	53.7	50.6	52.2	52.6	53.0	55.5
Overall width	66.2	62.4	62.2	61.8	60.0	63.4
Track, F/R	55.1/55.9	53.8/52.8	53.5/54.3	51.4/51.4	50.7/50.2	54.7/53.1
Ground clearance	4.6	7.0	6.0	5.7	7.0	4.9
Front head room	37.0	34.0	36.0	36.5	37.3	36.0
Front hip room	48.0	42.0	40.0	44.0	42.0	42.0
Front leg room	45.0	42.0	42.0	42.5	40.9	40.0
Rear head room	33.0	34.0	33.0	32.5	36.0	34.0
Rear hip room	48.0	48.0	52.0	49.0	45.0	50.0
Rear leg room (min.)	36.0	32.0	25.0	32.5	29.1	36.0
Rear knee room (min.)	3.0	2.0	−1.0	2.0	−0.5	−1.0
Couple distance	33.0	30.0	26.0	27.0	28.0	30.0
SPECIFICATIONS						
Engine type	SOHC in-line 4	SOHC in-line 4	SOHC in-line 4	SOHC in-line 4	In-line 4	SOHC in-line 4
Displacement (cu. in./L)	97/1.6	86/1.4	81/1.3	111/1.8	79/1.3	97/1.6
Compression ratio	23.0:1	8.8:1	9.3:1	22.0:1	9.0:1	23.0:1
Carburetion	F.I.	2-bbl.	3-bbl.	F.I.	2-bbl.	F.I.
Net hp @ rpm	52 @ 4,800	64 @ 5,000	67 @ 5,000	51 @ 5,000	58 @ 5,200	52 @ 4,800
Net torque @ rpm	72 @ 2,000	78 @ 3,000	79 @ 3,000	72 @ 3,000	67 @ 3,600	72 @ 2,000
Transmission	Five-speed manual	Four-speed manual	Five-speed manual	Four-speed manual	Five-speed manual	Five-speed manual
Axle ratio	4.11:1	3.17:1	n.a.	3.15:1	3.15:1	3.89:1
Tire make	Goodyear	B. F. Goodrich	Dunlop	Bridgestone	Dunlop	Continental
Tire type	Grand Prix S70 radial	Steel-belted radial	SP4N steel-belted radial	RD-108 steel-belted radial	SP4N steel-belted radial	TS771 steel-belted radial
Tire size	175/70SR13	155SR13	155SR13	155SR13	145SR13	175/70SR13
Steering	Rack and pinion, power	Rack and pinion, manual	Rack and pinion, manual	Rack and pinion, manual	Rack and pinion, manual	Rack and pinion, manual
Overall steering ratio	22.4:1	n.a.	17.9:1	Variable 21.2-25.5:1	15.7:1	20.8:1
Turns, lock to lock	3.4	3.0	3.5	4.7	3.1	3.9
Turn diameter (ft.)	38.5	35.5	35.5	30.1	30.2	31.2
Front suspension	Independent, MacPherson struts	Independent, MacPherson struts	Independent, MacPherson struts	Independent, unequal-length A-arms, coil springs	Independent, MacPherson struts	Independent, MacPherson struts
Rear suspension	Independent, torsion crank axle, coil springs	Independent, trailing arms, coil springs	Independent, MacPherson struts	Solid axle, three control links, coil springs	Solid axle, four control links, coil springs	Independent, torsion beam axle, coil springs
Front stabilizer-bar diameter (in.)	0.82	0.55	None	0.75	0.86	None
Rear stabilizer-bar diameter (in.)	0.71	None	None	None	None	None
Trailer towing (max. lbs.)	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended	No recommendation
Trailer tongue weight (max. lbs.)	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended	No recommendation
Brakes	Disc/drum, power	Disc/drum, power	Disc/drum, power	Disc/drum, power	Disc/drum, power	Disc/drum, power
Brake swept area (sq. in.)	n.a.	216.0	206.8	264.0	197.9	n.a.
Fuel tank (gal.)	15.8	10.6	10.8	13.7	10.6	10.6
Trunk space (cu. ft.)	12.0	11.0	10.0	9.9	10.0	22.0
Liftover height (in.)	29.0	34.0	27.0	29.0	32.0	30.0
Curb weight (lbs.)	2,260	1,982	1,795	2,235	1,725	2,026
F/R weight distribution (%)	63/37	63/37	61/39	57/43	54/46	60/40
Basic price	$10,515	$6,182	$5,899	$6,699	$5,578	$9,240
Price as tested	$11,615	$6,641	$6,099	$6,884	$5,578	$10,805
Major options (over $100) on test car	A/C $690, AM/FM stereo $200, speaker kit $210	Rear defroster $103	AM/FM radio $200	None	None	AM/FM stereo $525, A/C $690, alloy wheels $350
TEST RESULTS						
Acceleration (sec.)						
0-60 mph	36.0†	18.9	16.6	25.1	22.0	28.5
25-70 mph	*	n.a.	22.3	*	*	*
Brake test (cool) 60-0 mph						
Stopping distance (ft.)	170	190	184	192	209	163
Pedal pressure (lbs.)	62	103	65	35	100	90
Brake test (hot) 60-0 mph						
Stopping distance (ft.)	178	165	171	187	198	186
Pedal pressure (lbs.)	54	72	66	80	80	110
Interior noise @ 60 mph (dBA)	74	75	75	77	74	76
Handling test (mph)	60.0	59.8	59.0	58.3	59.8	58.0
Maneuverability test (mph)	27.6+	27.6+	27.6+	27.6+	27.6+	27.6+

TEST CONDITIONS: Ambient temperature, 55°F; relative humidity, 75 percent; barometric pressure, 29.96 inches Hg

† See text
* Couldn't reach 70 mph in specified distance

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Economy imports
—under $7,500

Here are the least costly, most fuel-efficient imports you can buy today

By JIM DUNNE

In the early 1950's imports first wedged their foot in the door of the high-volume U.S. car market. Volkswagen and Renault wore the shoes then. Today, the Japanese makers claim the bulk of import-car sales—80 percent—and most of those models are in the $7,500-and-under class. Europe still holds a piece of the pie, accounting for about 20 percent, though its mix includes a larger number of high-priced cars. Here's a capsule look at the '82 economy imports.

Toyota: The biggest-selling import has more models under $7,500 than any other. Starlet is Toyota's fuel-economy champ, with a 38/52 EPA rating for city/highway mileage (see car test). The newest version takes on standard items such as tinted glass, rear-window defogger, and a revised ignition system that smooths out the engine at idle speeds. Tercel comes in a variety of models, including two- and four-door sedans and a three-door hatchback, all carried over from '81 with little change. A four-speed automatic-overdrive transmission is now optional on Corolla models. Appearance is slightly altered on all Corollas by a new grille, hood, side-view mirrors, and taillight styling.

Datsun: The big news for Nissan Motor Corp. in 1982 is yet to come: a replacement for the 210 model. Called Sunny in Japan, the new car's differences from the 210 include a new body and chassis, front-wheel drive, and new 1.3- and 1.5-liter engines. The

Continued

PS buyer's guide to imports under $7,500

Manufacturer model	Length (in.)	Width (in.)	Height (in.)	Weight (lbs.)	Engine (liters)	Horse-power	Trans-mission	Body type	Base price ($)
Datsun (Nissan)									
210 Std.	165.0	62.2	53.7	1,905	1.2, OHV 4	58 @ 5,600	4-sp. man.	2-dr. sedan	4,799
210 MPG	165.0	62.2	53.7	1,945	1.4, OHV 4	65 @ 5,600	5-sp. man.	2-dr. sedan	5,139
210 Deluxe	165.0	62.2	52.5	2,015	1.5, OHV 4	65 @ 5,200	5-sp. man., 3-sp. auto.	2-dr. hatch.	5,149
	165.0	62.2	53.7	1,990	1.5, OHV 4	65 @ 5,200		4-dr. sedan	5,989
	167.7	62.2	52.5	2,070	1.5, OHV 4	65 @ 5,200		4-dr. wagon	6,299
310	160.6	63.8	53.5	1,892	1.5, OHV 4	67 @ 5,200	4-sp. man., 5-sp. man.	2-dr. hatch.	5,689
	160.6	63.8	53.5	1,958	1.5, OHV 4	67 @ 5,200		4-dr. hatch.	6,389
Stanza	170.9	65.2	53.9	2,152	2.0, OHV 4	88 @ 5,200	5-sp. man., 3-sp. auto.	2-dr. hatch.	6,799
	173.4	65.6	54.7	2,220	2.0, OHV 4	88 @ 5,200		4-dr. hatch.	6,999
Dodge/Plymouth									
Colt/Champ	156.9	62.4	50.0	1,876	1.4, OHC 4	70 @ 5,200	4-sp. man., 2×4-sp. man., 3-sp. auto.	2-dr. hatch.	5,543
Custom	156.9	62.4	50.0	1,969	1.6, OHC 4	80 @ 5,200		2-dr. hatch.	6,116
	161.0	62.6	50.0	1,951	1.4, OHC 4	70 @ 5,200		4-dr. hatch.	n.a.
Fiat									
Strada	161.0	64.9	55.1	2,105	1.5, OHC 4	75 @ 5,500	5-sp. man., 3-sp. auto.	2-dr. hatch.	6,198
	161.0	64.9	55.1	2,140	1.5, OHC 4	75 @ 5,500		4-dr. hatch.	6,357
Honda									
Civic 1300	148.4	62.2	53.2	1,761	1.3, OHC 4	60 @ 5,500	4-sp. man.	2-dr. hatch.	4,799
1300FE	148.4	62.2	53.2	1,795	1.3, OHC 4	60 @ 5,500	5-sp. man.	2-dr. hatch.	5,899
1500DX	148.4	62.2	53.2	1,854	1.5, OHC 4	67 @ 5,000	5-sp. man., 3-sp. auto.	2-dr. hatch.	5,849
Civic	161.4	62.2	53.2	1,967	1.5, OHC 4	67 @ 5,000		4-dr. sedan	6,749
	161.4	62.2	54.1	2,002	1.5, OHC 4	67 @ 5,000		4-dr. wagon	6,249
Isuzu									
Deluxe I-Mark (gas)	170.7	61.8	52.6	2,189	1.8, OHC 4	78 @ 4,800	5-sp. man., 3-sp. auto.	2-dr. sedan	6,372
	170.7	61.8	53.5	2,231	1.8, OHC 4	78 @ 4,800		4-dr. sedan	6,533
LS I-Mark (gas)	170.7	61.8	52.6	2,207	1.8, OHC 4	78 @ 4,800		2-dr. sedan	6,888
	170.7	61.8	53.5	2,260	1.8, OHC 4	78 @ 4,800		4-dr. sedan	7,003
I-Mark Coupe (diesel)	170.7	61.8	52.6	2,235	1.8, OHC 4	51 @ 5,000		2-dr. sedan	6,799
Deluxe I-Mark (diesel)	170.7	61.8	52.6	2,288	1.8, OHC 4	51 @ 5,000		2-dr. sedan	7,244
	170.7	61.8	53.5	2,339	1.8, OHC 4	51 @ 5,000		4-dr. sedan	7,405
Mazda									
GLC	159.1	64.2	54.1	1,900	1.5, OHC 4	68 @ 5,000	4-sp. man., 5-sp. man., 3-sp. auto.	2-dr. hatch.	5,295
	165.4	62.8	56.3	2,145	1.5, OHC 4	63 @ 5,000		4-dr. wagon	5,995
	166.8	64.2	54.1	1,945	1.5, OHC 4	68 @ 5,000		4-dr. sedan	6,245
626	173.8	65.4	54.5	2,585	2.0, OHC 4	74 @ 4,500	5-sp. man., 3-sp. auto.	2-dr. coupe	7,245
	173.8	65.4	53.3	2,585	2.0, OHC 4	74 @ 4,500		4-dr. sedan	7,545
Renault									
Le Car	142.5	60.0	55.0	1,820	1.4, OHV 4	n.a.	4-sp. man.	2-dr. hatch.	4,795
	142.5	60.0	55.0	1,820	1.4, OHV 4	n.a.		4-dr. hatch.	5,295
Subaru									
STD	156.9	63.4	53.7	2,050	1.6, OHV 4	67 @ 4,800	4-sp. man.	2-dr. hatch.	4,839
DL	156.9	63.4	53.7	2,060	1.6, OHV 4	67 @ 4,800	5-sp. man.	2-dr. hatch.	5,794
	167.3	63.4	53.7	2,130	1.6, OHV 4	67 @ 4,800		4-dr. sedan	6,144
	168.5	63.4	54.7	2,250	1.8, OHV 4	71 @ 4,400		4-dr. wagon	6,394
DL 4WD	168.3	63.8	56.9	2,375	1.8, OHV 4	71 @ 4,400	4-sp. man.	4-dr. wagon	7,019
DL hardtop	167.3	63.4	53.1	2,110	1.6, OHV 4	67 @ 4,800	5-sp. man.	2-dr. coupe	6,294
GL	157.9	63.6	53.7	2,120	1.8, OHV 4	71 @ 4,400	5-sp. man., 3-sp. auto	2-dr. hatch.	6,289
GL 4WD	156.7	63.8	55.7	2,240	1.8, OHV 4	71 @ 4,400	dual-range 4-sp. man.	2-dr. hatch.	6,889
	168.1	63.6	53.7	2,190	1.8, OHV 4	71 @ 4,400	5-sp. man., 3-sp. auto.	4-dr. sedan	6,639
	169.3	63.6	54.7	2,310	1.8, OHV 4	71 @ 4,400		4-dr. wagon	6,889
GL 4WD	168.3	63.8	56.9	2,410	1.8, OHV 4	71 @ 4,400	dual-range 4-sp. man.	4-dr. wagon	7,489
GLF hardtop	168.1	63.6	53.1	2,180	1.8, OHV 4	71 @ 4,400	5-sp. man., 3-sp. auto.	2-dr. coupe	6,889
Toyota									
Tercel	161.2	61.0	52.6	1,900	1.5, OHC 4	62 @ 5,200	4-sp. man., 5-sp. man., 3-sp. auto.	2-dr. sedan	4,998
	161.2	61.0	52.6	1,935	1.5, OHC 4	62 @ 5,200		4-dr. sedan	5,548
	161.2	61.0	52.6	1,940	1.5, OHC 4	62 @ 5,200		2-dr. hatch.	6,018
Starlet	152.2	60.0	53.0	1,724	1.3, OHV 4	58 @ 5,200	5-sp. man.	2-dr. hatch.	5,578
Corolla	166.3	63.4	53.0	2,176	1.8, OHV 4	70 @ 4,600	4-sp. man., 5-sp. man., 3-sp. auto., 4-sp. auto.	2-dr. sedan	5,548
	166.3	63.4	53.0	2,310	1.8, OHV 4	70 @ 4,600		4-dr. sedan	6,438
	168.9	63.4	53.0	2,330	1.8, OHV 4	70 @ 4,600		4-dr. wagon	6,508
	168.3	64.0	50.8	2,330	1.8, OHV 4	70 @ 4,600		2-dr. hatch.	6,648
Corolla SR5	168.3	64.0	50.8	2,330	1.8, OHV 4	70 @ 4,600		2-dr. coupe	7,148
Celica ST	176.2	65.6	52.0	2,513	2.4, OHC 4	96 @ 4,800	5-sp. man., 3-sp. auto	2-dr. coupe	7,159

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We just brought our gas mileage up to speed.

All across the country, you'll see signs announcing the best gas mileage car in America. The new Honda Civic 1300 FE Hatchback.

The official figures put it this way. EPA estimated 41 mpg. And estimated 55 highway. You should use 41 mpg for comparison only. Actual highway mileage will probably be less. Your mileage may differ depending on speed, weather and trip length. And California figures will be only 2 miles per gallon less.

While the highway signs remind you of our good mileage, we'd like to remind you that Honda places no limits on good engineering.

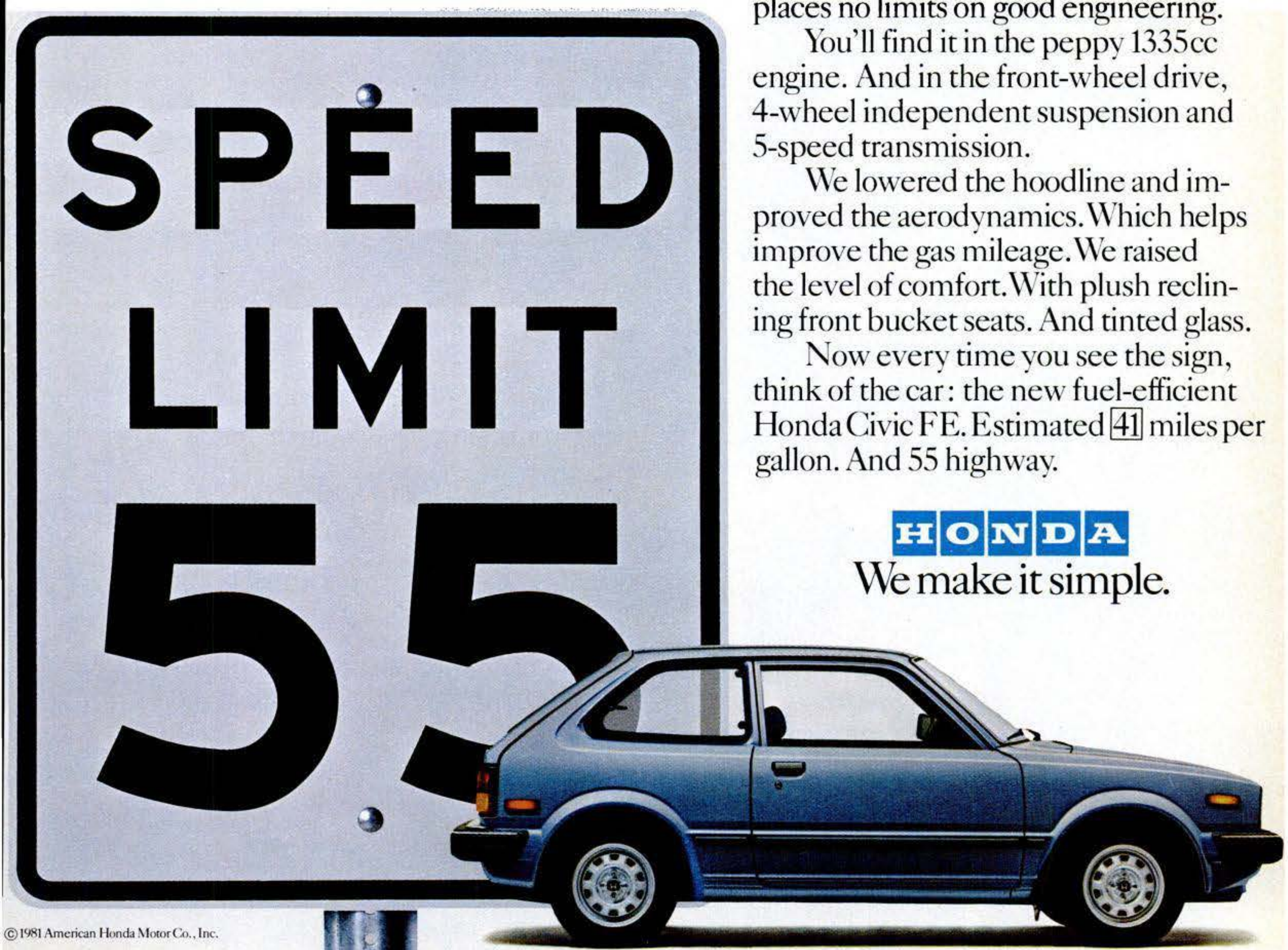
You'll find it in the peppy 1335cc engine. And in the front-wheel drive, 4-wheel independent suspension and 5-speed transmission.

We lowered the hoodline and improved the aerodynamics. Which helps improve the gas mileage. We raised the level of comfort. With plush reclining front bucket seats. And tinted glass.

Now every time you see the sign, think of the car: the new fuel-efficient Honda Civic FE. Estimated 41 miles per gallon. And 55 highway.

HONDA

We make it simple.



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210 will be dropped when the new model arrives in the summer of '82.

No less impressive is the introduction of the Nissan Stanza. (The "Nissan" name makes its debut on this model; Nissan Motor Corp. plans to phase out the "Datsun" nameplate gradually.) Replacing the 510, this car, too, is all-new, and features front-drive and a new two-liter, four-cylinder engine in wedge-shaped two- and four-door hatchbacks. Features include four-wheel independent suspension, a maintenance-free battery, radial tires, and rack-and-pinion steering. Stanza has an EPA rating of 32/46 mpg.

Honda: The Civic 1300 FE, says Honda, is the top gas-mileage car in the U.S. (see car test). It offers a 41/55 mpg fuel-economy rating by the EPA. A 1,335-cc-displacement four-cylinder engine is standard in this car. Styling changes in Civics are minimal, restricted to urethane-rubber-protected front and rear bumpers.

Dodge Colt/Plymouth Champ: These Mitsubishi-made twins now include a five-door sedan. It has a 3.1-inch-longer wheelbase, which adds three inches to rear-seat leg room. Chrysler officials predict the new body style will make up 40 percent of 1982 sales. The four-door's fuel economy is the same as the two-door's.

Mazda: A Sport option has been added to the GLC line to put some pizazz in this basic economy car. The new model comes with special suspension and an upgraded interior. Wagons have more changes. The roof line is higher, and rear springs are relocat-

On the waterfront (clockwise, from lower left): Mazda GLC hatchback, Subaru GL wagon, Toyota Corolla SR5 coupe, Renault 5 (Le Car)

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ed to provide more head room—½ inch in front and 1½ inches in the rear. In addition, there is better noise isolation, thanks to more insulation in the front. To improve the ride, the shock-absorber valving is refined.

Subaru: The sporty hardtop has a new grille that features blackout plastic instead of chrome and quad halogen rectangular headlights. Standard on all cars is a 15.8-gallon fuel tank, maintenance-free battery, hill-holder clutch, and lumbar-support adjustment for front seats. Inside, the instrument panel has a new look that features vertical-read gauges.

Renault: The last year before Renault begins producing cars in the U.S. sees little change in the made-in-France R5. A four-door model, added during the '81 model year, is continued. The R5 also has detail engine adjustments that raise EPA city fuel economy to 32 for city driving. Highway economy remains at 40 mpg.

Fiat: Though reports indicate that Fiat will put heavy emphasis on sports models and downgrade the importance of its sedans, the Strada is alive and well for 1982. It's a near rerun of the 1981 model. However, new, low-rolling-resistance tires are standard with the optional alloy wheels.

Isuzu: A new name in the 1981 model year, Isuzu already is changing a number of features for 1982. Isuzu interiors are described as "all-new." The GM-affiliated Japanese maker offers three I-Mark versions in two body styles, including a diesel coupe that is among the top-fuel-economy cars sold in this country. PS

four-door hatchback, and the all-new Nissan Stanza four-door hatchback from Datsun. Inset: the Dodge Colt four-door hatchback.

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Mid-priced cars

–$7,500 to $15,000

Five stylish imports (seen clockwise from foreground) near their port of entry: Toyota Celica Supra, Mazda RX-7 GSL, Volkswagen Quantum station wagon, Volkswagen Vanagon diesel, and Peugeot 505 Turbodiesel.

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High performance, luxury, and innovative features highlight the new models from Europe and Japan

By ED JACOBS

Perhaps the most surprising development from American car makers this year was the sudden rebirth of genuine high-performance cars. Even more surprising, then, is the resurgence of high-performance cars among mid-priced imports, of which more than a half-dozen strong-hearted and responsive new models have already arrived or are due later this year.

Families and fuel economy haven't been forgotten, however. There will be more diesel-powered fuel pinchers this year, of course, but even some of them are turbocharged. There's even a lively turbocharged station wagon for the family in a hurry. For families a bit less concerned with hustle, some of the familiar names now sport distinctive new bodies or have been replaced by new car lines.

The biggest news comes from Japan again this year. Toyota has redesigned the sporty Celica Supra to look and perform substantially better. The car now has a rakish wedge profile and a host of performance-boosting features: 2.8-liter twin-cam engine (29 hp stronger), fuel injection, five-speed transmission, four-wheel disc brakes, independent rear suspension, and fat, sticky tires.

Honda has given the long-acclaimed Accord a stylish new body. The car is as well thought out and equipped as ever and offers a longer wheelbase for increased stability, front and rear spoilers, and a larger fuel tank (almost 16 gallons).

Over at Datsun, the 200-SX has undergone a face lift to give it a soft, energy-absorbing front end. And the 280-ZX Turbo has been given the five-speed manual transmission that so many people have asked for.

From across the Atlantic, France is sending the sleek Renault Fuego and Fuego Turbo coupes, sporty derivatives of the 18i. Their handling and performance differences put them a notch or two above their sibling, as I found when I drove a European Fuego

Continued

Nissan's Datsun 200-SX hardtop (top left) and hatchback have been revised for a longer, lower appearance. Saab's 900S (left center) uses special low-rolling-resistance tires for improved fuel economy. Renault 18i's flashy cousin, Fuego (left), comes in high-performance models with or without turbocharging.

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PS buyer's guide to mid-priced imports

Manufacturer model	Length (in.)	Width (in.)	Height (in.)	Weight (lbs.)	Engine (liters)	Horsepower	Trans-mission	Body types	Base price ($)
Audi									
4000 4E	176.6	66.3	53.7	2,146	1.7, OHC 4	74 @ 5,000	5-sp. man.	2-dr.	9,755
4000S	176.6	66.3	53.7	2,146	1.7, OHC 4	74 @ 5,000	5-sp. man., 3-sp. auto.	4-dr.	10,865
4000 Diesel	176.6	66.3	53.7	2,146	1.6, OHC 4	52 @ 4,800	5-sp. man.	4-dr.	10,515
Coupe	177.0	66.3	53.1	2,507	2.2, OHC 5	100 @ 5,100	5-sp. man.,	2-dr.	12,370
5000S	188.9	69.6	54.7	2,703	2.2, OHC 5	100 @ 5,100	3-sp. auto.	4-dr.	13,665
5000S Diesel	188.9	69.6	54.7	2,747	2.0, OHC 5	67 @ 4,800	5-sp. man.	4-dr.	13,990
5000 Turbo	188.9	69.6	54.7	3,042	2.2, OHC 5	130 @ 5,400	3-sp. auto.	4-dr.	16,490
BMW									
320i	177.5	63.4	54.3	2,500	1.8, OHC 4	101 @ 5,800	5-sp. man., 3-sp. auto.	2-dr.	13,290
Datsun/Nissan									
200-SX	176.2	66.1	51.6	2,576	2.2, OHC 4	102 @ 5,200		2-dr.	7,739
200-SX Hatch.	176.2	66.1	51.6	2,611	2.2, OHC 4	102 @ 5,200		2-dr. hatch.	7,938
Maxima	183.3	64.6	54.5	2,794	2.4, OHC 6	120 @ 5,200		4-dr.	11,049
Maxima Diesel	183.3	64.6	54.5	2,794	2.8, OHC 6	80 @ 4,600		4-dr.	11,419
Maxima wagon	186.8	64.6	55.7	2,897	2.4, OHC 6	120 @ 5,200	5-sp. man.,	4-dr. wagon	11,859
Maxima Diesel wagon	186.8	64.6	55.7	2,897	2.8, OHC 6	80 @ 4,600	3-sp. auto.	4-dr. wagon	12,229
280-ZX	174.0	66.5	51.0	2,757	2.8, OHC 6	145 @ 5,200		2-dr.	14,499
280-ZX 2+2	181.9	66.5	51.4	2,891	2.8, OHC 6	145 @ 5,200		2-dr.	15,499
280-ZX Turbo	174.0	66.5	51.0	2,867	2.8, OHC 6	180 @ 5,600		2-dr.	17,299
280-ZX Turbo 2+2	181.9	66.5	51.0	3,007	2.8, OHC 6	180 @ 5,600		2-dr.	18,299
Dodge									
Challenger	180.0	65.9	52.8	2,833	2.6, OHC 4	105 @ 5,000	5-sp. man., 3-sp. auto.	2-dr.	8,036
Fiat									
X1/9	156.2	61.8	46.5	2,140	1.5, OHC 4	75 @ 5,500	5-sp. man.	2-dr. conv.	10,900
Spider 2000	163.0	63.5	48.2	2,360	2.0, OHC 4	102 @ 5,500	5-sp. man., 3-sp. auto.	2-dr. conv.	12,290
Spider 2000 Turbo	163.0	63.5	48.2	2,385	2.0, OHC 4	120 @ 6,000	5-sp. man.	2-dr. conv.	14,995
Honda									
Accord sedan	173.6	63.8	53.3	2,169	1.8, OHC 4	75 @ 4,500	5-sp. man.,	4-dr.	8,245
Accord LX	165.8	65.0	53.3	2,175	1.8, OHC 4	75 @ 4,500	3-sp. auto.	2-dr. hatch.	8,449
Prelude	161.4	64.4	51.0	2,138	1.8, OHC 4	75 @ 4,500		2-dr.	7,995
Mazda									
626 Luxury 2-dr.	173.8	65.4	54.5	2,585	2.0, OHC 4	74 @ 4,500		2-dr.	8,845
626 Luxury 4-dr.	173.8	65.4	54.5	2,585	2.0, OHC 4	74 @ 4,500		4-dr.	9,345
RX-7 S	170.1	65.7	49.6	2,345	1.1, Rotary	100 @ 6,000	5-sp. man.,	2-dr.	9,695
RX-7 GS	170.1	65.7	49.6	2,345	1.1, Rotary	100 @ 6,000	3-sp. auto.	2-dr.	10,295
RX-7 GSL	170.1	65.7	49.6	2,345	1.1, Rotary	100 @ 6,000		2-dr.	11,895
Peugeot									
504 Diesel	194.4	66.7	61.0	3,300	2.3, OHV 4	71 @ 4,500	4-sp. man.	4-dr. wagon	11,900
505	186.7	68.4	56.4	3,020	2.0, OHV 4	96 @ 4,900	5-sp. man., 3-sp. auto.	4-dr.	10,990
505 D	186.7	68.4	56.4	3,020	2.3, OHV 4	71 @ 4,500	4-sp. man., 3-sp. auto.	4-dr.	12,390
505 Turbodiesel	186.7	68.4	56.4	3,250	2.3, OHV 4	80 @ 4,150	5-sp. man.,	4-dr.	13,570
505 STI	186.7	68.4	56.4	3,200	2.0, OHV 4	96 @ 4,900	3-sp. auto.	4-dr.	14,990
Plymouth									
Sapporo	180.0	65.9	52.8	2,833	2.6, OHC 4	105 @ 5,000	5-sp. man., 3-sp. auto.	2-dr.	8,036
Renault									
Fuego	176.8	66.6	50.5	2,379	1.6, OHV 4	81 @ 5,500	5-sp. man., 3-sp. auto.	2-dr.	8,500*
Fuego Turbo	176.8	66.6	50.5	2,379	1.6, OHV 4	114 @ 5,500	5-sp. man.	2-dr.	12,500*
18i	178.7	66.5	55.3	2,261	1.6, OHV 4	81 @ 5,500	4-sp., 5-sp. man.,	4-dr.	8,000*
18i wagon	181.5	66.5	55.2	2,405	1.6, OHV 4	81 @ 5,500	3-sp. auto.	4-dr. wagon	8,500*
Saab									
900	187.6	66.5	55.9	2,580	2.0, OHC 4	110 @ 5,250	5-sp. man.,	2-dr. hatch.,	10,400
900 S	187.6	66.5	55.9	2,580	2.0, OHC 4	110 @ 5,250	3-sp. auto.	4-dr.	12,100
900 Turbo	187.6	66.5	55.9	2,630	2.0, OHC 4	135 @ 4,800			15,600
Toyota									
Corona sedan	176.8	65.2	53.9	2,599	2.4, OHC 4	96 @ 4,800		4-dr.	8,939
Corona hatch.	176.8	65.2	53.0	2,619	2.4, OHC 4	96 @ 4,800		4-dr. hatch.	9,199
Corona wagon	180.5	65.2	54.3	2,619	2.4, OHC 4	96 @ 4,800	5-sp. man.,	4-dr. wagon	7,549
Celica Supra	183.5	66.3	52.0	2,932	2.8, OHC 6	145 @ 5,200	4-sp. auto.	2-dr. hatch.	13,598
Celica Supra L	183.5	66.3	52.0	2,932	2.8, OHC 6	145 @ 5,200		2-dr. hatch.	14,598
Cressida	184.8	66.5	54.3	2,861	2.8, OHC 6	116 @ 4,800	4-sp. auto.	4-dr.	12,249
Cressida wagon	185.2	66.5	55.5	2,905	2.8, OHC 6	116 @ 4,800	4-sp. auto.	4-dr. wagon	12,699
Volkswagen									
Rabbit convertible	155.3	63.4	55.6	2,204	1.7, OHC 4	74 @ 5,000	5-sp. man.,	2-dr. conv.	10,595
Jetta	167.8	63.4	55.5	1,892	1.7, OHC 4	74 @ 5,000	3-sp. auto.	2-dr., 4-dr.	8,375
Jetta Diesel	167.8	63.4	55.5	1,892	1.6, OHC 4	52 @ 4,800	5-sp. man.	2-dr., 4-dr.	9,020
Scirocco	165.7	64.0	51.4	2,028	1.7, OHC 4	74 @ 5,000		2-dr.	10,150
Quantum	178.1	66.9	55.1	2,280	1.7, OHC 4	74 @ 5,000	5-sp. man.,	2-dr., 4-dr.	10,250
Quantum wagon	183.1	66.9	55.1	2,280	1.7, OHC 4	74 @ 5,000	3-sp. auto.	4-dr. wagon	10,950
Vanagon	179.9	72.6	77.2	3,175	2.0, OHV 4	67 @ 4,200	4-sp. man., 3-sp. auto.	4-dr. van	11,360
Vanagon Diesel	179.9	72.6	77.2	n.a.	1.6, OHC 4	52 @ 4,800	4-sp. man.	4-dr. van	11,885
Vanagon camper	179.9	72.6	80.7	3,527	2.0, OHV 4	67 @ 4,200	4-sp. man., 3-sp. auto.	3-dr. camper	14,900
Vanagon Diesel camper	179.9	72.6	80.7	n.a.	1.6, OHC 4	52 @ 4,800	4-sp. man.	3-dr. camper	15,425
Volvo									
DL, GL	192.5	67.3	56.2	2,879	2.2, OHC 4	98 @ 5,000	4-sp. man. + O.D., 4-sp. auto.	2-dr., 4-dr.	9,785
DL, GL diesel	192.5	67.3	56.2	3,049	2.4, OHC 6	78 @ 4,800	4-sp. man. + O.D., 3-sp. auto.	4-dr.	12,990
DL, GL wagon	192.5	67.3	57.5	3,129	2.2, OHC 4	98 @ 5,000	4-sp. man. + O.D., 4-sp. auto.	4-dr. wagon	10,760
DL, GL diesel wagon	192.5	67.3	57.5	3,177	2.4, OHC 6	78 @ 4,800	4-sp. man. + O.D., 3-sp. auto.	4-dr. wagon	13,810
GLT	192.5	67.3	56.2	2,917	2.2, OHC 4	105 @ 5,400	4-sp. man. + O.D.	2-dr.	11,945
GLT Turbo	192.5	67.3	56.2	2,967	2.2, OHC 4	127 @ 5,400	4-sp. man. + O.D.,	2-dr., 4-dr.	14,610
GLT Turbo wagon	192.5	67.3	57.5	3,165	2.2, OHC 4	127 @ 5,400	4-sp. auto.	4-dr. wagon	15,470
GLE	192.5	67.3	56.2	3,095	2.7, OHC V6	134 @ 5,500	3-sp. auto.	4-dr.	16,390

*Estimated

GTX several thousand miles through the Alps last winter.

Renault will introduce a diesel version of the 18i later this year, which will be designated as an '83 model. A turbodiesel version is also likely, but much later on.

Peugeot has added a special 505 STI model this year. It's a four-door sedan with a gasoline engine and all of the special equipment from the model S plus cruise control, leather seats, and the special Michelin TRX handling package and tires. You can get it in any color you want, as long as it's black or metallic red.

In Sweden, Volvo is building a lively, turbocharged, gasoline-powered station wagon capable of zero-to-60-mph acceleration in about 10 seconds. More importantly, Volvo's diesels are again available (an admitted EPA test error disqualified them last year) on the DL and more-luxurious GL models, including the station wagons. There's also a new four-speed automatic overdrive transmission available as an option on most models.

Saab, meanwhile, has added a variable-boost system to its turbos so the engines can run without fear of engine-damaging knock. New low-rolling-resistance Pirelli P8 tires on the 900 and 900S models give better fuel economy.

Volkswagen has replaced the Dasher with the new Quantum [PS, Jan.] built as a two-door hatchback, four-door wagon, and four-door sedan (to be released in a few weeks). The cars feature some of the most aerodynamically efficient body work around and promise high fuel economy.

Scirocco has a slippery new body that also promises high fuel efficiency. The car's most striking feature is its unique, patented rear spoiler, which runs across the lower part of the rear-window glass. It may look unusual, but VW claims it cuts drag by a whopping 11 percent.

For those who want a fuel-stingy van, VW has shoehorned the Rabbit's miserly diesel engine into the Vanagon—by tilting it *51 degrees* from vertical and installing an aluminum radiator and electric fan up front.

That's not all we're getting this year. Volkswagen will soon announce a turbodiesel for VW and Audi products—probably the Jetta and 4000.

The car I'm waiting for, though, is the supercharged Mazda RX-7. Since turbochargers aren't fully effective on Wankels, the RX-7 will use a mechanically driven supercharger. The car is expected later this year, and—as hot as it is now—the supercharger should turn it into a fire breather. We'll keep you posted. PS

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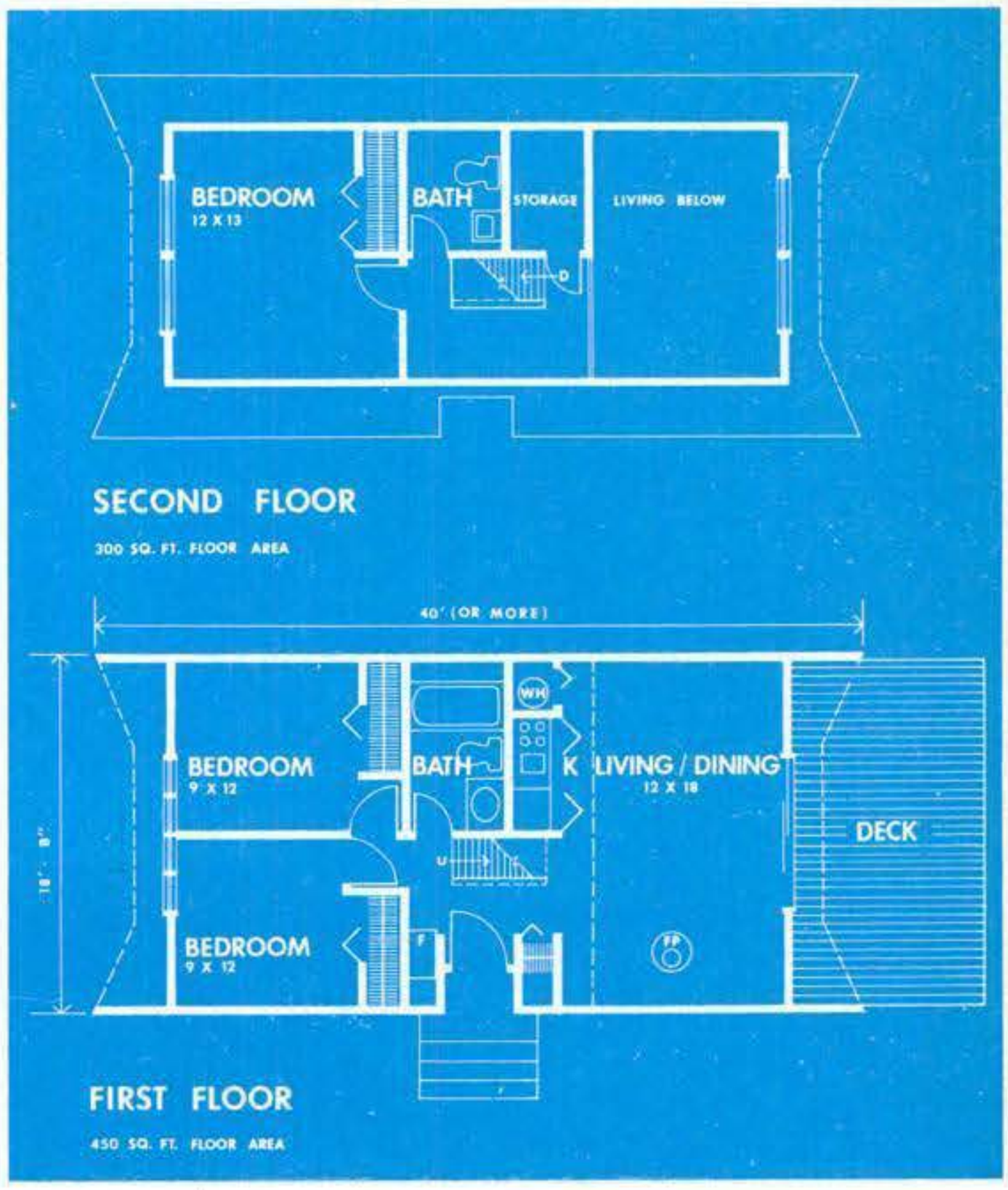
Flat-top A-frame

By AL LEES

This month begins the tenth year of this series, so what better way to celebrate than by presenting one final variation on a design that's proved consistently popular in previous versions? It's the truncated A-frame that takes its name from the architect who created it: Robert Martin Engelbrecht. This two-story version of the Engelframe boasts the same energy efficiency as previous variations: By chopping off the useless, heat-trapping peak of the standard A-frame, you assure a cozier interior on chill days. And if you can site your end wall so that the full-height glass can soak up solar heat during the winter, you'll find that the windowless side walls are easily insulated to contain it.

The plan length can be extended for larger or additional rooms, but even as shown the partial, loft-type upper story provides a master bedroom, half-bath, and storage. PS



Here's how to order your V-PAC plans

Construction plans for this Engelframe (VPS #56) are $65 a set, $95 for three, $135 for five, plus postage/handling charge of $3 in continental U.S., $5 elsewhere. Catalog of V-PAC plans is $5; of all Engelframe designs, $4. Send check (U.S. funds) to Vacation Plans Service, Box 622, Princeton, N.J. 08540. For MasterCard or Visa orders, call (609) 924-9655. V-PAC Council, a group of building-materials manufacturers, includes American General (stairs), Andersen (windows), Olympic (stains), Du Pont (finishes), Whirlpool (appliances), GAF (roofing), Georgia-Pacific (paneling), Heatilator (fireplaces), Johns-Manville (insulation), Myers (pumps), Pass & Seymour (electrical), Simpson (lumber), Singer (heating), and Universal-Rundle (baths).

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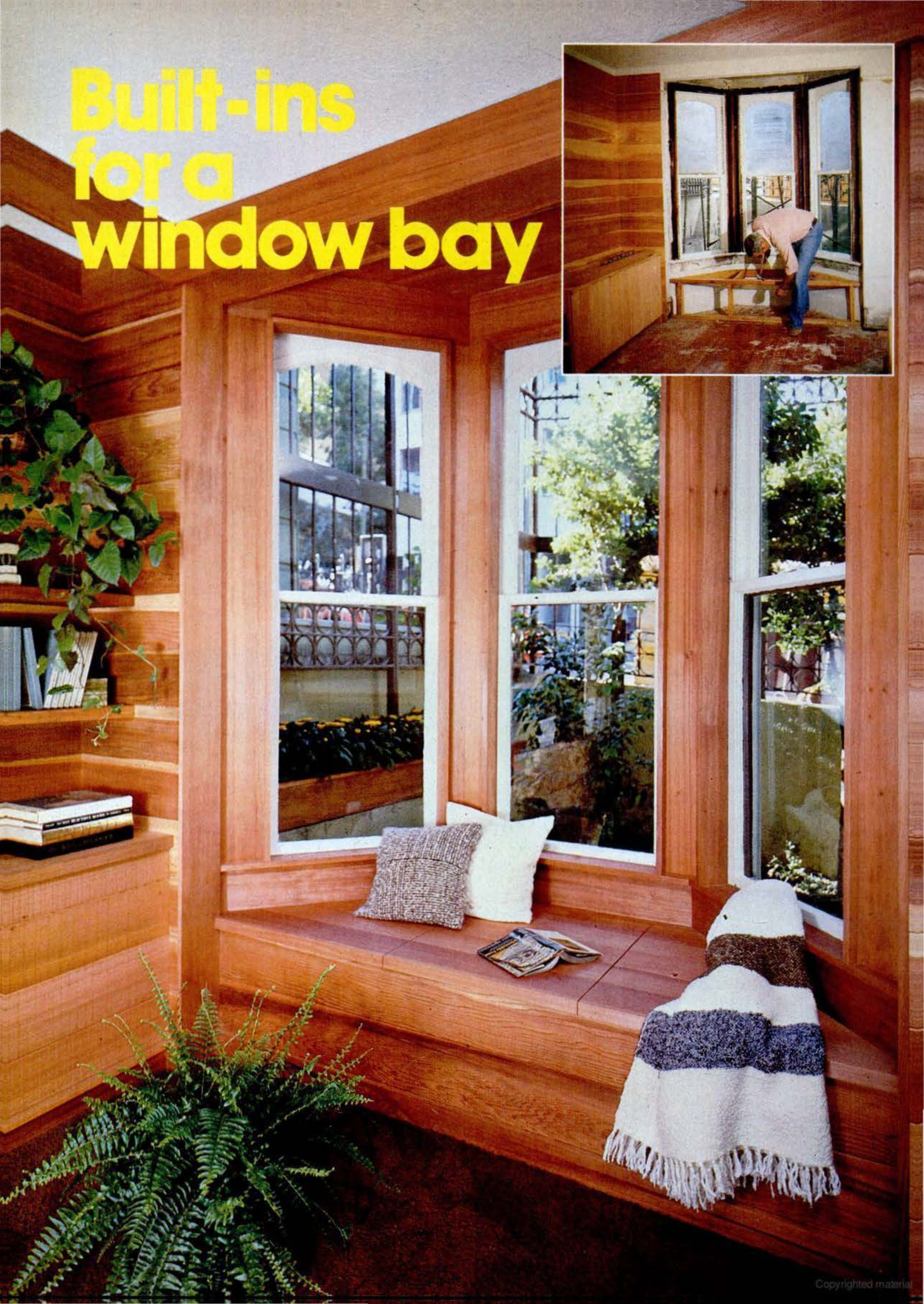
Built-ins for a window bay



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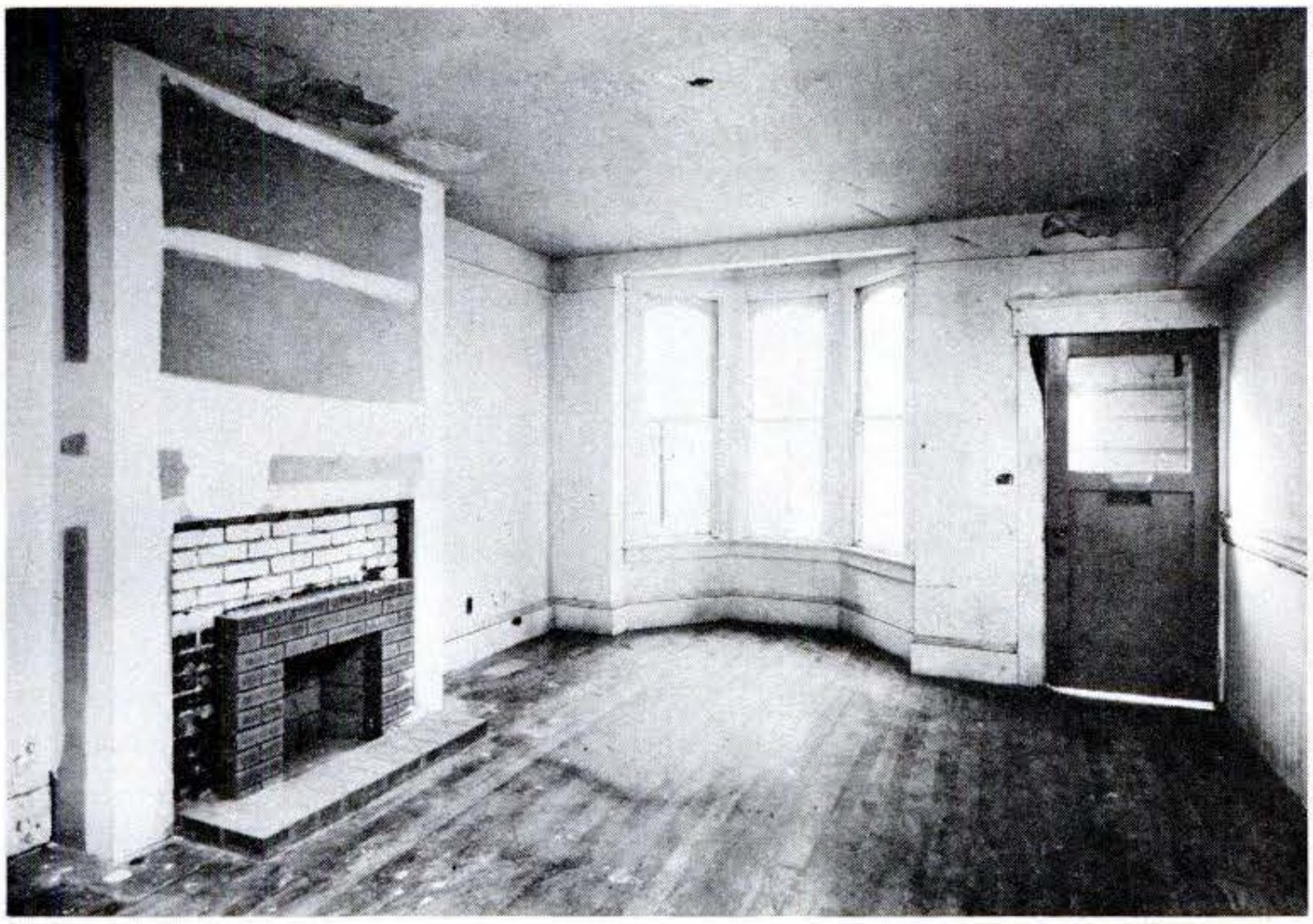
A redwood window seat and cabinet add storage to an inviting alcove

By DAN RUBY

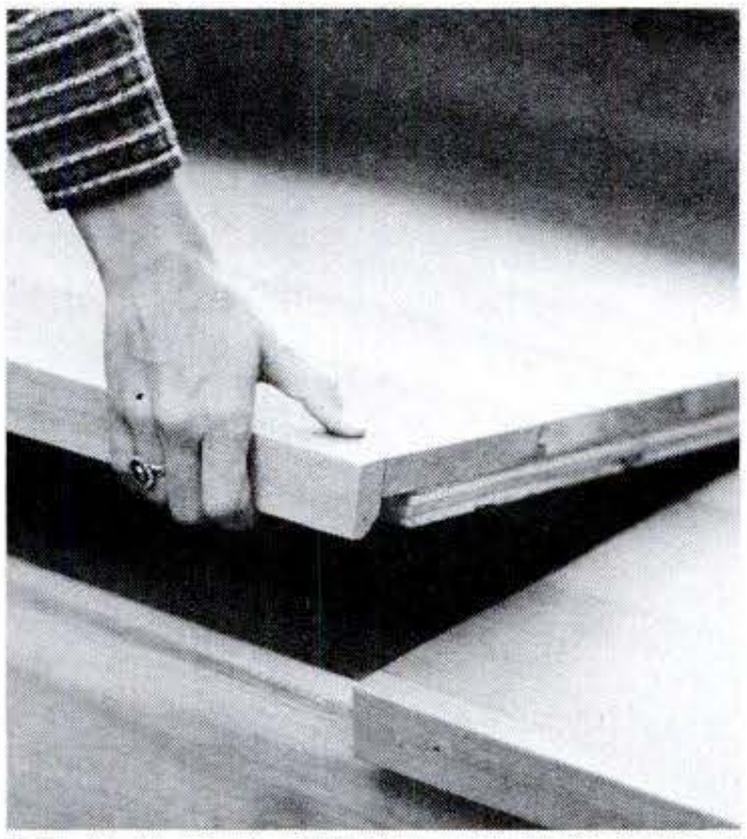
Hidden beneath the cracked plaster, rotted moldings, and layer upon layer of paint in the old San Francisco townhouse were some charming features. In Marshall Roath's all-redwood renovation, the three-foot-deep window bay became the living room's visual centerpiece with the addition of a built-in bench and adjacent cabinet. And they provide what almost every living room, new or old, lacks: concealed storage space.

While the entire room is surfaced in redwood, a wide range of grades, textures, and board sizes are used for variety. The windows themselves are framed with smooth redwood 1×4's to contrast with the rough-textured resawed paneling that covers the walls and front faces of the cabinets. Similarly, top-quality clear-all-heart boards are varied with sapwood-streaked clear-grade for greater interest. (For complete information on the types and uses of redwood, write to the California Redwood Assn., 1 Lombard St., San Francisco, Calif. 94111, for a literature list.)

The seat and cabinet are framed with lumber as shown, then faced with tongue-and-groove paneling applied directly over the framing in some places and glued to plywood sheathing in others. Both storage units have a hinged center panel for access (a lid or a door) featuring unobtrusive hardware. Three long 2×12 shelves over the cabinet give space for display. PS

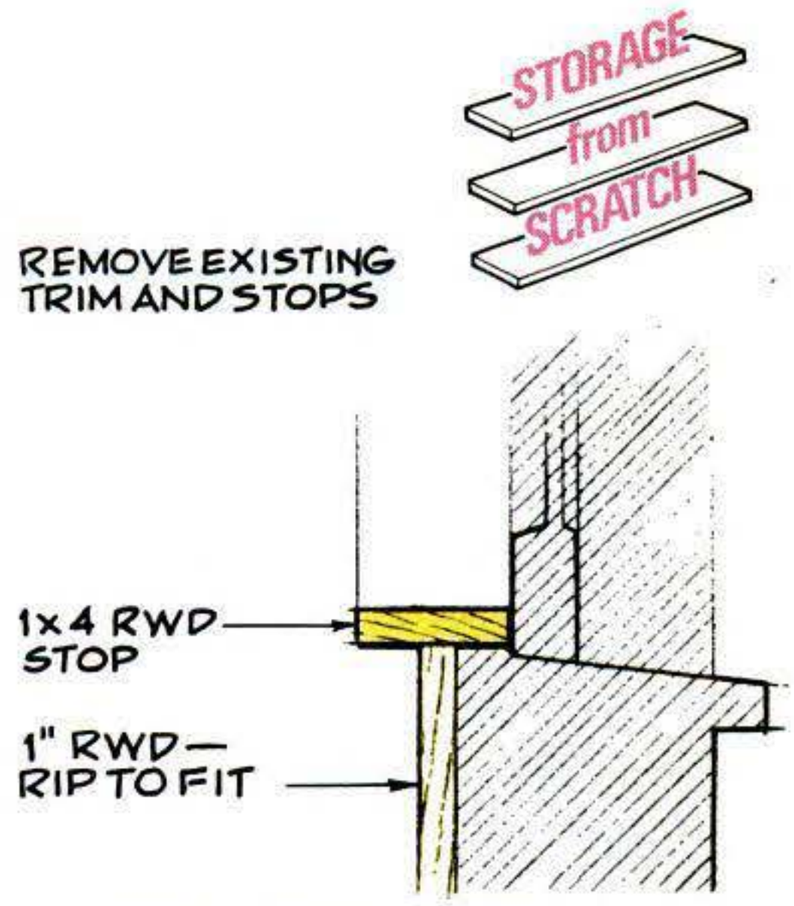


Run-down interior offered several niches for built-in storage—notably a window bay.

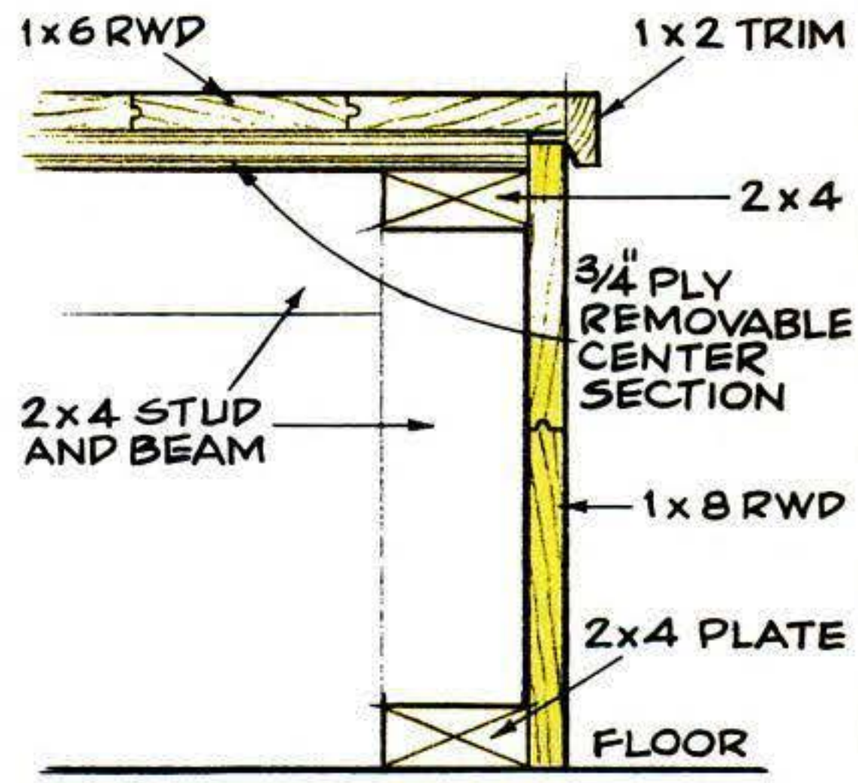


Window seat's lid lifts to give access to 15 cu. ft. of easy-to-reach storage. T&G planks are used for all cabinet surfaces.

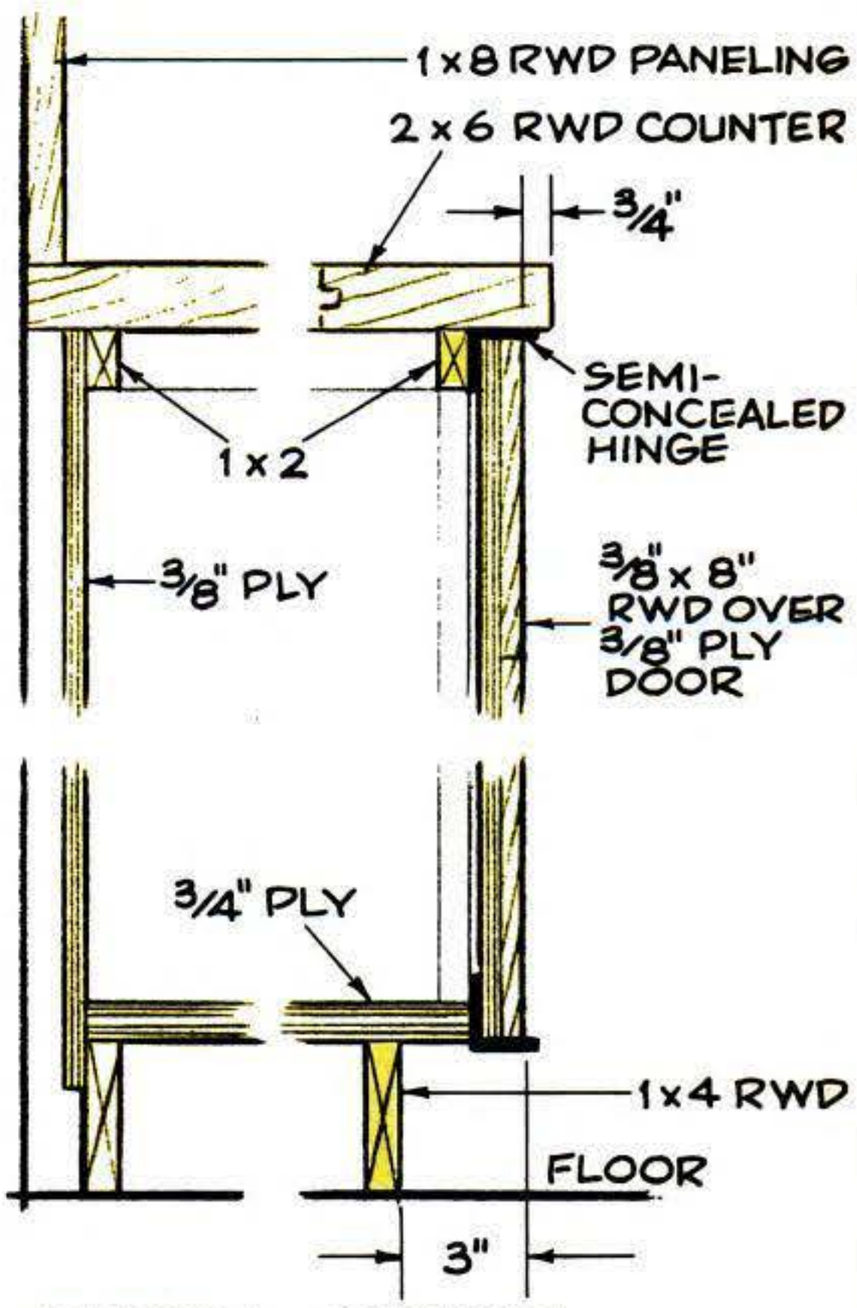
Windows get the redwood treatment after existing casings are stripped. Original curved top sashes were retained.



WINDOW TRIM DETAIL



SECTION—WINDOW SEAT



SECTION—CABINET

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Fast furniture finishes

Can they compare with the old, painstaking ways? PS test results

They brush on smoothly and dry quickly, but do they look as good?

By THOMAS JONES
PHOTO BY GREG SHARKO

You may have spent hours sanding, scraping, staining, and sealing a piece of unfinished furniture. But it's the final finish that makes your work look professional—or amateurish.

For years, I was convinced that varnish was the only good finish. That's because I started out using varnish. Actually, my father used it, and I did the sanding between coats. Despite this odious division of labor, when I started finishing on my own, I stuck with varnish—dust, bubbles, brush marks, sags, and all.

Over the years I've used brushing lacquer, shellac, and linseed oil—the other basic finishes available. All took considerable time and effort to apply, but each produced a handsome top coat.

Now, store shelves are crowded with tung oil, polyurethane, and other synthetic-resin varnishes. The labels claim these products will solve everyone's finishing problems. No sanding between coats. Hand-rubbed satin and antique finishes right out of the can. Fast, foolproof finishes.

But in the rush to get the job done, are we putting a really fine finish on our furniture projects?

To answer this question, I did extensive testing. I wanted to see if the modern miracle concoctions were better than, or even as good as, the old familiar finishes.

There are three basic types of clear top coats: penetrating finishes that sink into the wood pores and leave a relatively thin surface coating; padding finishes (applied with a pad) that leave a micro-thin surface coating; and surface finishes, either satin or glossy, that simply deposit a protective film on the wood. I tested a selection of all of these, trying out each on several different woods. I followed the manufacturer's directions for each product, except in the last test of glossy surface finishes. There, I also tried applying some new products with old methods.

My primary criterion in judging the results was appearance of the final sample. The second—but important—consideration was how well the finish protected the wood from water and alcohol. I noted ease of application, but did not consider it in judging the finish, since I was concerned with results.

The result of each test is detailed in the tables. Here are my conclusions: Some new finishes are clearly superior to the traditional ones. With these you will get the same good looks, with less effort. Other finishes, while easier to apply than traditional ones, will give inferior results if you simply follow the manufacturer's instructions. But if you use more traditional finishing procedures, the newer finishes will look about as good as the old.

Penetrating-oil finishes

As a group, penetrating-oil finishes are the easiest to apply. There are no worries about brush marks, dust, bubbles, or sags. Although the procedures vary slightly from product to product, you basically slop the finish on, wait, then wipe off the excess.

Linseed oil is the original penetrating finish. Some craftsmen swear by it; others condemn it as a finish that is all work for little result. Some say you must apply it monthly for a year, then yearly forever after. That may be exaggerating a bit. But four months after using linseed oil on my test sample, I could still smell the finish, which meant it hadn't yet dried.

The new penetrating finishes are mixtures of oils, synthetic and natural resins, and petroleum solvents. All are easier and quicker to apply than linseed oil (see table for details).

Like linseed oil, the new finishes produced a natural-wood look and texture with a slight sheen; but linseed oil resisted alcohol and water some-

Continued

Penetrating finishes

	Product	Main ingredients	Application	Final appearance (non-waxed sheen) Teak	Pine	Mahogany	Water and alcohol resistance
Old finish	Linseed oil	Polymerized vegetable oil	Cut linseed oil 1:2 with turpentine (use only "boiled" oil; raw won't dry), apply, let soak, then wipe: once daily for a week, once weekly for a month	Slight	Slight	Moderate	Good
New finishes	DPS (deep-penetrating sealer)	Tung oil	Apply, let drain off, wait 24 hours, repeat	Slight	Flat	Slight	Bare finishes had good resistance. With optional "protective" wax coating, all showed slight clouding
	Tungseal	Tung oil	Apply, let penetrate, wipe dry, repeat (two coats on mahogany and teak, four coats on pine)	Slight	Flat	Slight	
	Watco Danish Oil	Linseed oil	Apply, wet-sand with 600A wet or dry paper, wipe dry. Apply second coat when dry, let penetrate, wipe dry	Flat	Flat	Slight	

Padding finishes

	Product	Main ingredients	Application	Final appearance Myrtle Burl	Walnut	Mahogany	Water and alcohol resistance
Old finish	French polish	Orange shellac	Dribble some shellac onto a wad of surgical cotton, enfold in a cloth pad, moisten with alcohol, lubricate sparingly with linseed oil. Rub thin coat onto surface with circular motion. Let dry 24 hours. Repeat for three more coats. Apply two final coats with the grain to eliminate swirl marks. Waxing is optional	Rich, mirror-smooth, transparent shine, highlighting color and figure of grain	Rich, mirror-smooth, transparent	Rich, mirror-smooth, transparent	None
New finishes	Pad Lac	Shellac pre-mixed with moisteners and lubricants	Apply about 1/4 oz. onto pad, tap pad to disperse liquid throughout, rub thin coat on surface with circular motion. Wait 24 hours. Repeat for three more coats. Apply two final coats with the grain	Same as above	Same as above	Same as above	None
	Rapid Pad	Same as above	Same as above	Glossy and transparent, but soft	Glossy, transparent, soft	Glossy, transparent, soft	None

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what better. For this test, half of each sample was waxed; then separate puddles of Gordon's gin and water were left to stand overnight on each half.

On balance, I judge the packaged penetrating-oil finishes I tested to be as good as, or better than, linseed oil.

Padding finishes

French polish is a top coat of shellac rubbed on in very thin coats by a pad moistened with alcohol and lubricated with linseed oil.

Surface preparation for padding a top coat is very important. The padded film is so thin that it will not correct surface defects. The wood must be thoroughly sanded, and a sealer coat of diluted shellac should be applied by brush before padding the finish on.

French polish is time-consuming (see table) and very difficult to master, but if you do it right, you get a finish that's unsurpassed in bringing out the rich color and grain of the wood. Unfortunately, the finish is not water- or alcohol-resistant. Nor is it as durable under normal wear as varnish. You use French polish only on fine furniture that won't be subjected to wear, abrasion, or spills.

The modern versions of French polish are prepared substitutes that don't need alcohol or oil for successful application. They are easier to apply successfully than the traditional French polish, but the wood surface must be prepared the same way.

In my test the Pad Lac sample looked as fine as the finish obtained by traditional French polishing.

Rapid Pad also looked good, but the finish was soft enough to be scratched by a fingernail. This product builds fast—commercial restorers use it in just one session. If you're in a hurry, use it. But if you want a traditional padded finish, use a product like Pad Lac.

Film top coat

If you want a more durable high-gloss finish, you can apply several coats of varnish, lacquer, or shellac. Some of the coating sinks into open wood pores but most stays on the surface, forming a thin, protective skin.

Satin and flat surface top coats

	Product	Main ingredients	Application	Leveling on pine	Sample appearance Pore filling on mahogany	Pore filling on cherry	Initial sheen
Old finishes	Varnish (gloss ZAR)	Polyurethane (today's most widely available equivalent of rubbing varnish)	3 coats: first and second thinned, light sanding between coats	Good	Fair	Fair	Gloss
	Shellac	Natural resin in alcohol	8 coats: thorough sanding after fourth and seventh coats	Poor	Good	Good	Gloss
New finishes	Antique ZAR	Polyurethane with silica	3 coats: first and second thinned, light sanding between coats	Good	Fair	Fair	Flat
	Deft Clear Wood Finish	Nitrocellulose, coconut oil, alkyd lacquer	3 coats: light sanding between coats	Good	Poor	Poor	Flat
	Satin brushing lacquer	Nitrocellulose lacquer	4 coats: light sanding between coats	Very poor	Fair	Good	Flat
	Satin Minwax	Polyurethane with silica	3 coats: light sanding between coats	Good	Fair	Fair	Satin
	Satin Varathane	Polyurethane with silica	3 coats: light sanding between coats	Good	Fair	Fair	Satin
	Wood Glo	Polyurethane with silica	2 coats: light sanding between coats	Good	Poor	Poor	Flat

Gloss surface top coats

	Product	Main ingredients	Application	Appearance after application of finish: Walnut	Cherry
Old finishes	Gloss brushing lacquer	Nitrocellulose lacquer	6 coats: first coat thinned as sealer, other coats full strength; thorough sanding and steel-wool rubdown between all coats	High gloss, brush marks, surface pores filled	High gloss, brush marks
	Shellac	Natural resin in alcohol	8 coats: first coat diluted, other coats full strength (3-pound cut); thorough sanding after fourth and seventh coats	High gloss, brush marks, surface pores filled	High gloss
	Varnish: All varnishes are listed below because today's available varnishes have such altered resin content (synthetic instead of organic) that they can't be classified as old finishes				
New finishes (applied according to manufacturers' directions)	Deft Wood Armor Gloss	Acrylic-latex finish	3 coats, full strength: light sanding between coats	Moderately glossy surface, pores not filled, but not as prominent as above	Moderately glossy surface, pores filled equal to Gloss Varathane, surface wavy with grain
	DPS/PF	Tung-oil varnish	2 coats DPS sealer: let dry; rub with 0000 steel wool and DPS, wipe clean, immediately apply DPS/PF; let dry, repeat rubdown and second coat DPS/PF	Glossy surface, pores not filled, surface wavy with grain	Glossy surface, pores not completely filled
	Gloss Varathane	Polyurethane varnish	3 coats, full strength: thorough sanding after first coat, light sanding after second	Surface glossy, pores not filled, surface wavy with grain	Surface less glossy than Gloss ZAR (below), pores better filled, surface wavy with grain
	Gloss ZAR	Polyurethane varnish	3 coats: first and second thinned, third coat full strength; thorough sanding after first coat, light sanding after second	Surface glossy, pores not filled, surface wavy with grain	Glossy surface, pores not filled, surface wavy with grain
New finishes (using old methods)	Barrett Coachman	Alkyd varnish	6 coats: first coat thinned as sealer, other coats full strength; thorough sanding and steel-wool rubdown between all coats	High gloss, mirror-flat surface, pores filled	High gloss
	Hour Varnish	Tung-oil varnish	6 coats: same procedures as above	High gloss, mirror-flat surface, pores filled	High gloss, brush marks
	Gloss ZAR	Polyurethane varnish	6 coats: same procedures as above	High gloss, mirror-flat surface, pores filled	High gloss, mirror-flat surface

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For a satin or antique (flat) finish that doesn't penetrate the wood, you can use lacquer or varnish products clouded with silica. These give the same dull finish that you formerly got only by rubbing down gloss varnish with pumice and rottenstone (see table).

Thirty years ago, most varnishes were solutions of natural gum resins in linseed or tung oil. Today's varnishes are made from oils, resins, and chemicals dissolved in petroleum solvents. But there is no universal varnish. Each product is formulated for a particular job. Bar-top varnish, for example, must resist water, alcohol, and detergents, and must have a good, long-lasting gloss. Floor varnish must be more flexible and have good abrasion resistance; high gloss is less important. Neither of these is satisfactory for fine furniture.

Like varnishes, the components of lacquer have changed over the years. The original lacquers were basically shellac. Today's lacquers are made from nitrocellulose (and other bases), resins, plasticizers, and solvents. Though trickier to work with than most varnishes, lacquer has an advantage: It really is colorless. Varnishes described as "water white" are actually pale yellow.

Shellac is an organic resin dissolved in alcohol. Once widely used as a top coat, shellac is most often used today only as a sealer, because of its poor alcohol and water resistance. But my tests show that it's surprisingly effective when applied properly.

Film-finish tests

The traditional way to get a satin or antique finish is to rub down shellac or gloss varnish with pumice and rottenstone. There are many new finishes on the market that don't require this final step (see table). My objective was to see if they were as good. I also wanted to find out if they filled the wood pores any better.

I tested old and new products on unstained, unfilled wood samples. All—except for the brushing lacquer and shellac—brushed on easily and leveled well. As in previous tests, I let puddles of gin and water sit overnight on waxed and unwaxed samples of the finish. The shellac sample gave me a surprise. Everyone knows that shellac doesn't resist either substance well, yet my sample came through unscathed. All other samples (both satin and gloss) were undamaged, as well, so I haven't included these tests in the tables.

Although satin and antique finishes can hide many surface defects, none of the finishes used could substitute for paste filler in filling wood pores.

In appearance, the new products produced results almost as good as the old rubbing with pumice and rottenstone. On close examination, the surfaces were not quite as smooth.

For the final gloss-finish test, I added an extra step. Besides applying new finishes according to manufacturers' directions, I used the old methods with some. One new finish, gloss ZAR, served as control.

The sanding made a difference. While the fast-finish samples displayed the pored surfaces noted in the previous test, the samples that were heavily sanded between coats were glassy smooth. Final rubbings with pumice and rottenstone gave them a high-gloss, glare-free mirror finish.

My conclusions? There is no way you can get a good varnish, shellac, or lacquer surface-film top coat without sanding between coats—paying particular attention to sanding before the final coat. Container instructions that say no sanding is required mean that succeeding coats will adhere without sanding. But if you want a smooth finish, sand between coats. PS

Rubbing and waxing	Final surface	Finish evaluation: Pine	Mahogany	Cherry
Sanding 400A and oil, pumice and oil, rottenstone and oil, wax on half of surface	Satin	Excellent	Fair (pores not filled)	Not tested
Same as above	Satin	Excellent	Excellent	Excellent
None	Flat	Excellent	Fair (pores not filled)	Excellent
Waxed	Satin	Excellent	Fair (pores not filled)	Good (pores not filled)
Pumice and oil, rottenstone and oil, wax	Satin	Poor (brush marks still show)	Poor (brush marks, and pores not filled)	Poor (brush marks, and pores not filled)
None	Satin	Excellent	Fair (pores not filled)	Not tested
None	Satin	Excellent	Fair (pores not filled)	Not tested
None	Flat	Excellent	Fair (pores not filled)	Good

Final-coat rubdown	Final appearance (not waxed except where noted)
Rub with pumice and oil, rottenstone and oil, compound; buff with lamb's-wool pad on hand drill (no wax)	Mirror finish
Same as above	Mirror finish
Not done	Satin
Rub down with pumice and oil, rottenstone and oil (mfr.'s procedure), paste wax, and buff	Glossy when waxed
Not done	Glossy
Not done	Glossy
Rub with pumice and oil, rottenstone and oil, compound; buff with lamb's-wool pad on hand drill (no wax)	Mirror finish
Rub down as above (no wax)	Mirror finish
Same procedure as above	Mirror finish

Tables show importance of sanding between coats. Another secret to a smooth finish: Use disposable polyfoam brushes. They apply a thin coat of varnish without brush marks or dropped bristles. Although most poly brushes are marked "not for shellac or lacquer," they can be used for both. They may last for only one coat—but if you buy in box lots, the brushes will be cheap enough to be discarded after one use.

When sanding before the first two coats, use 280-grit garnet or aluminum oxide paper. Or use 320 or 400A wet or dry silicon carbide paper. A felt-backed block will keep the paper flat on the work. Sand until the surface is dull except for pores and depressions. Then rub with 0000 steel wool to dull these spots. For the last sanding, use the 320 or 400A silicon carbide paper lubricated with water (oil for shellac). Rub with 0000 steel wool, clean thoroughly, and let dry.

SOME MAIL-ORDER SOURCES

Constantine, 2050 Eastchester Rd., Bronx NY 10461 (Wood-Glo, Pad Lac, Watco, lacquer); **Craftsman Wood Service,** 1735 West Corland Ct., Addison IL 60101 (brushing lacquer, Watco, Barrett, Deft); **John Harra Wood & Supply Co.,** 511 W. 25th St., New York NY 10001 (DPS, DPS/PF); **Mohawk Finishing Products,** Amsterdam NY 12010 (lacquer, Rapid Pad); **Woodworkers Store,** 21801 Industrial Blvd., Rogers MN 55374 (Barrett, ZAR, Deft, Minwax, Watco). Unfinished cabinet in color photo courtesy of Master Craftsman, New York NY.

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PS AUTOMOTIVE-MAINTENANCE FILE PAGE

How to splice, solder, and connect automotive wiring

By RAY HILL
DRAWINGS BY ADOLPH BROTMAN

Your car's taillights have stopped working. An investigation reveals that a piece of luggage in the trunk has severed the ground wire. Or . . .

Your headlight is very dim. The cause is a corroded terminal at the end of the headlight's ground wire. It's so rusted that cleaning it is impossible. Or . . .

You've bought a CB radio. But its feed wire isn't long enough to reach the car's fuse block.

To solve these problems you must repair a broken wire, replace a corroded terminal, or lengthen a wire. These are just a few of the jobs that a basic knowledge of working with automotive electrical wiring will enable you to perform. Knowing three simple splices, how to use a stripping-crimping tool, how to solder, and how to use various solderless connectors and terminals will let you handle most automotive electrical repairs.

Three common splices (drawing A) are the tap, Western Union, and pigtail. The tap, as the name implies, is used when one wire must be tapped into another. The Western Union (the strongest splice you can make) and the pigtail are used to join two wires.

Although the tap and Western Union splices are strong enough mechanically to hold together, it's best to solder them whenever possible, as insurance. The weak pigtail must be soldered. After you complete each splice, wrap it with electrical tape for insulation.

The equivalents of these three splices can also be made with solderless connectors: tap-splice equivalent (B), Western Union (C), pigtail (D).

Solderless terminals (E) are handy when a terminal needs replacing. The procedure for fastening one to the end of a stripped wire is similar to crimping a butt connector (the tubular connector used to make the equivalent of a Western Union splice). Crimp portion "1" of the terminal, being sure to use the proper set of crimper jaws (they are marked). Crimp portion "2" with the insulation jaws, marked INS on the tool.

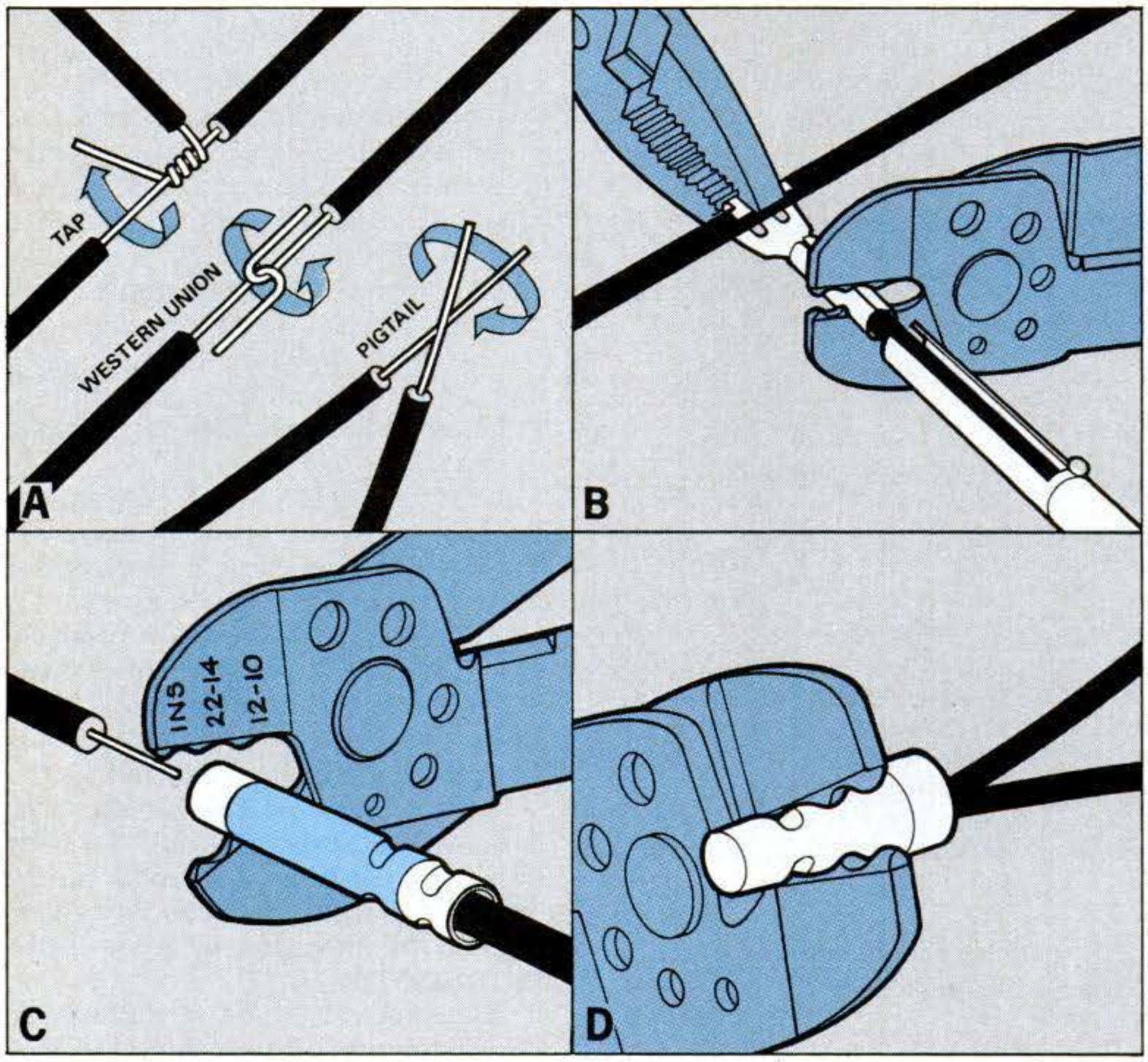
For a connection that can be plugged in and unplugged, connectors F and G are useful.

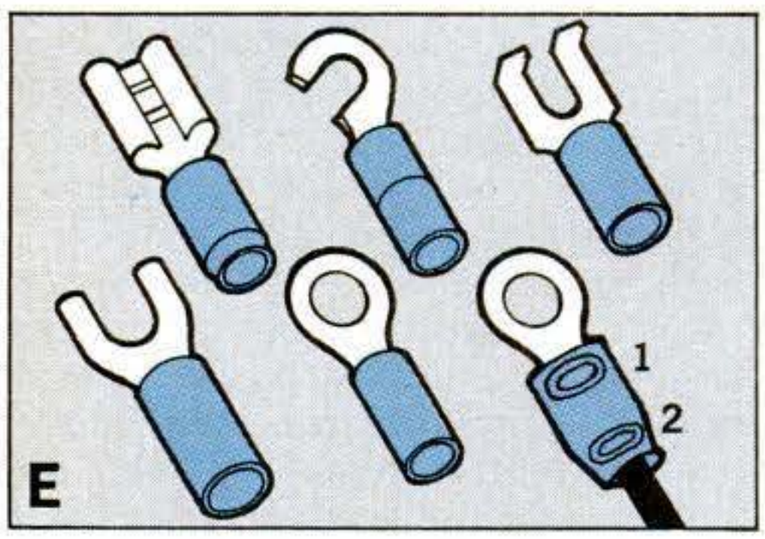
When soldering a connection (H), use electrical rosin-core solder.

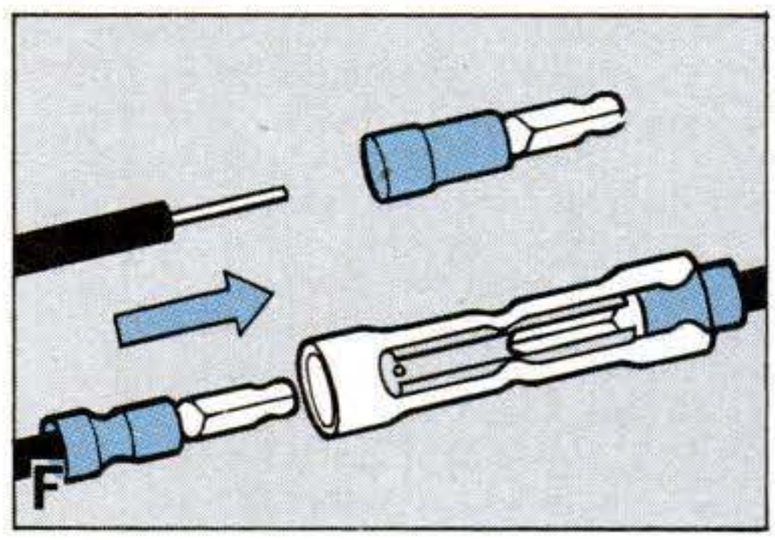
Some safety tips:

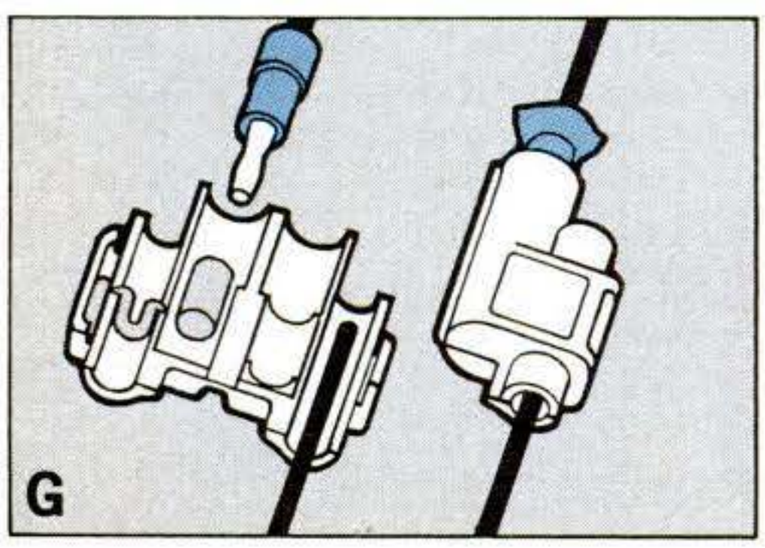
- When splicing wires or hooking up accessories on your car, disconnect the battery ground cable first. This disables the electrical system, preventing damage in case the wrong terminals or bare wires accidentally touch.
- Wear safety glasses. This is especially important when you're working in a position in which you must look up—under the dash, for example.
- Never replace a wire with one smaller than the original; for instance, if the original was 14 gauge, the replacement should be, too.

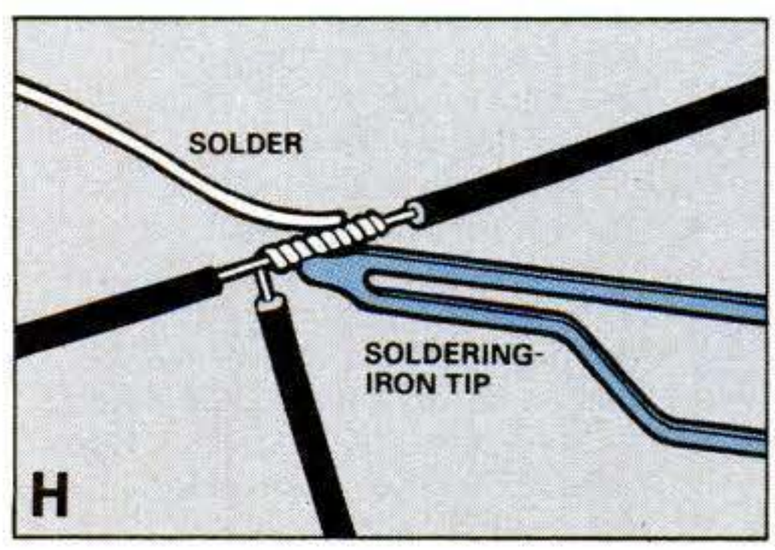
Armed with these techniques and hints, you'll be ready to tackle most automotive electrical chores you're faced with. PS











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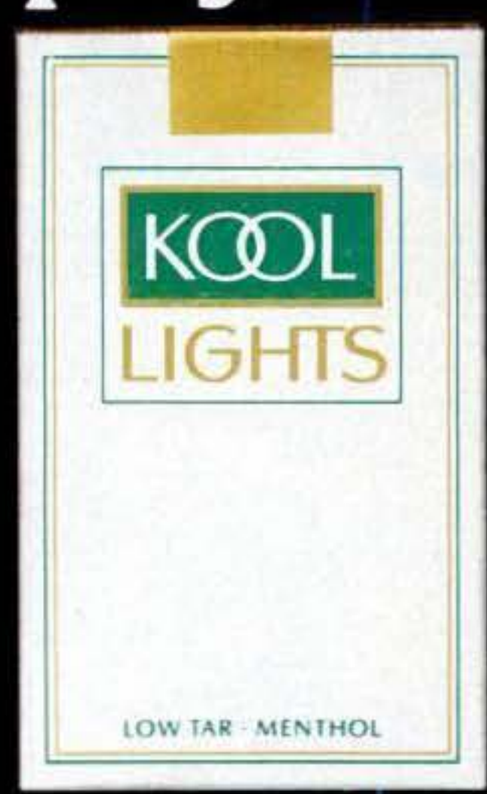

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WORDLESS WORKSHOP

By ROY DOTY

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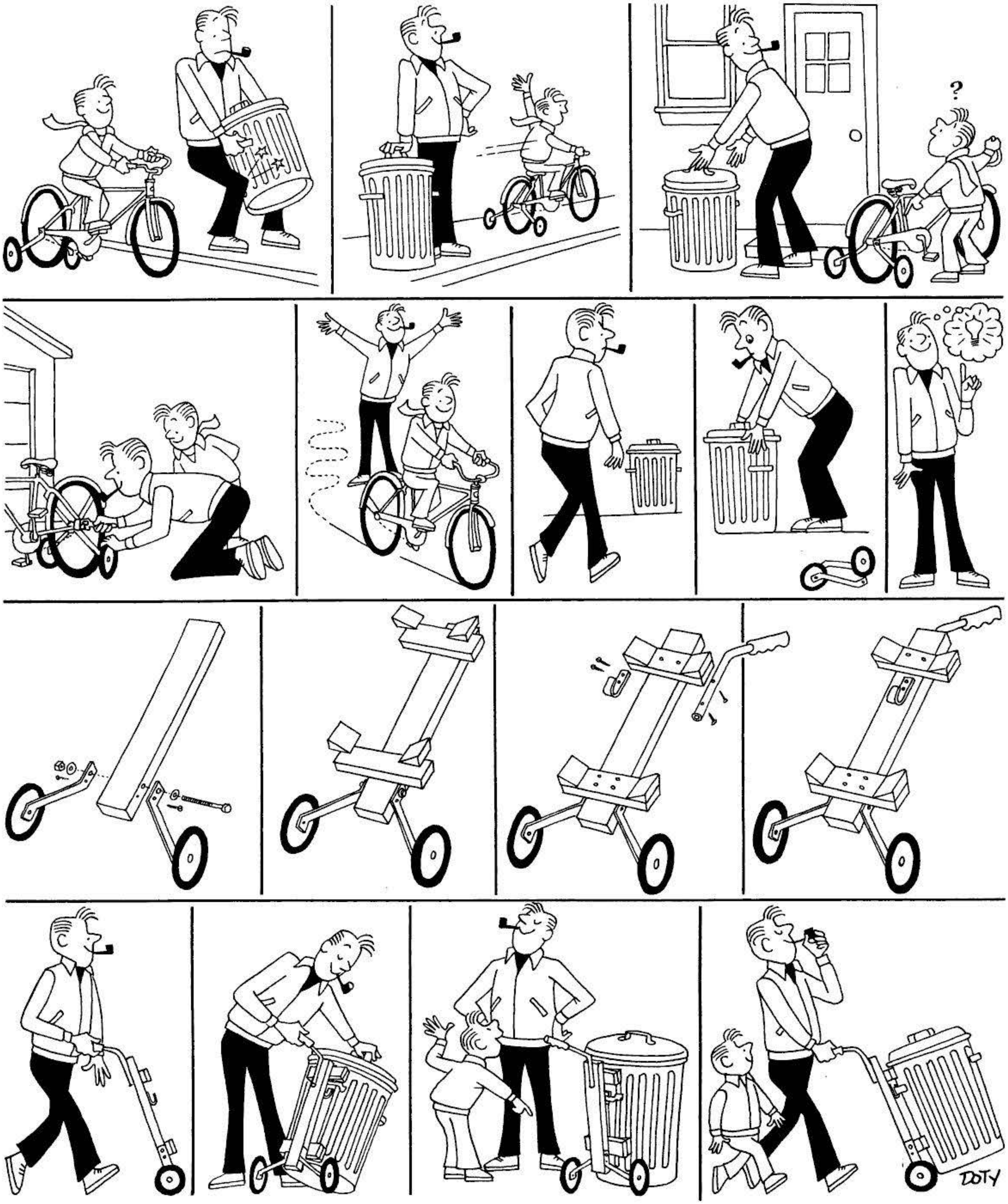

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VIC-3K Memory Expander Cartridge / $39.95

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VIC-20 Super Expander — 3K RAM memory expansion, high resolution graphics plotting, color, and sound commands. / $69.95

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VIC-20 Programmers Reference Guide — Master VIC-20 reference manual includes information on VIC BASIC, programming and much more. /$16.95

To order accessories simply list on separate sheet and clip to coupon.

Personal Computer Comparison Chart

Product Features	Commodore VIC-20	Atari 400	TI 99/4A	TRS-80 Color Computer
Price*	**$299.95**	$399.95	$525.00	$399.50
Total Memory Standard (ROM & RAM)	**25K**	26K	42K	12K
Memory (RAM) Expansion to...	**32K**	Not Available	Not Available	32K
Keyboard Style	**Full-Size Typewriter Style**	Flat Plastic Membrane	Half-size Typewriter	Calculator Style
Programmable Function Keys	**4**	0	0	0
Basic Language	**Microsoft Basic**	$59.95 Extra	TI Basic	Radio Shack Basic
Upper/Lower Case Characters	**Yes**	Yes	No	No
RS232 Interface	**$49.95**	$219.95	$225.00	$19.95
Number of Keys	**66**	57	40	53
Graphic Symbols on Keyboard	**62**	0	0	0
Displayable Characters	**512**	256	64	256

*Manufacturers suggested retail price September 1, 1981

A computer like this would have been science fiction a few years ago. Now it's a reality. It's the new VIC-20 by Commodore, a full fledged expandable color computer that costs little more than video games. And it's so easy to use you can be writing your first program in 15 minutes!

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The VIC-20 also plays music, has exciting graphics, lets you create pictures. It even tells you when you've made a mistake and how to correct it. (That's very friendly!)

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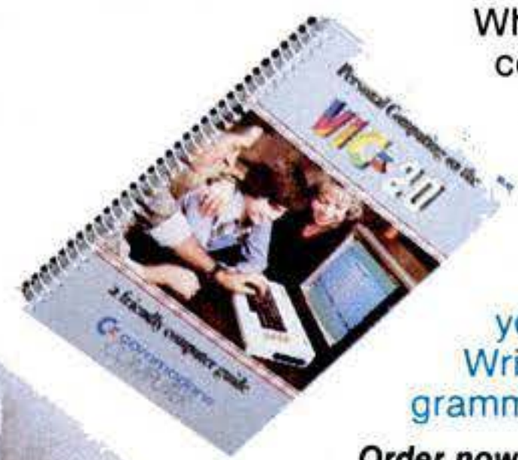

Why get just another game that could end up in the closet? Get an honest-to-goodness computer for just $299.95.

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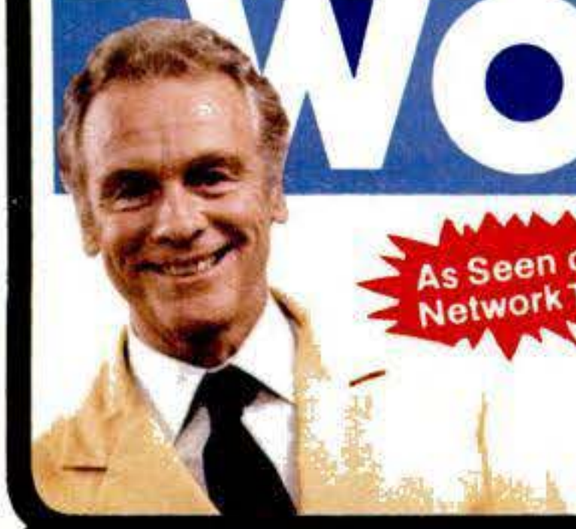

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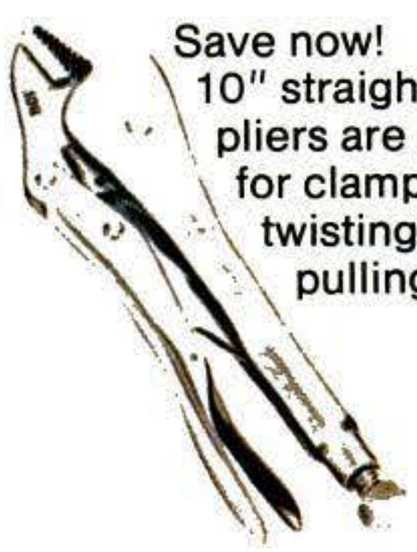

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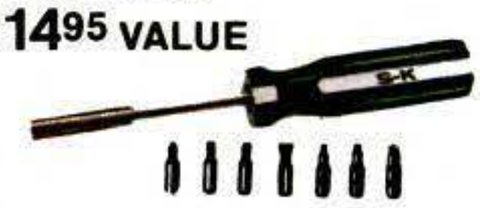

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PS PULL-OUT DATA PAGE

Tapping into water pipes

By RICHARD DAY

It's often necessary to tap into a pipe: To install a bar sink, for example. Or maybe to add an extra outlet for your garden hose. There are many useful adapters, tap-tees, and special unions available from your hardware/home-center dealer. Knowing what connectors are available and how to use them can spell the difference between a job that's done right and one that leaks.

The accompanying photos show the more important fittings and a few of their applications. And here are specific do's and don'ts about putting some of them to work for you:

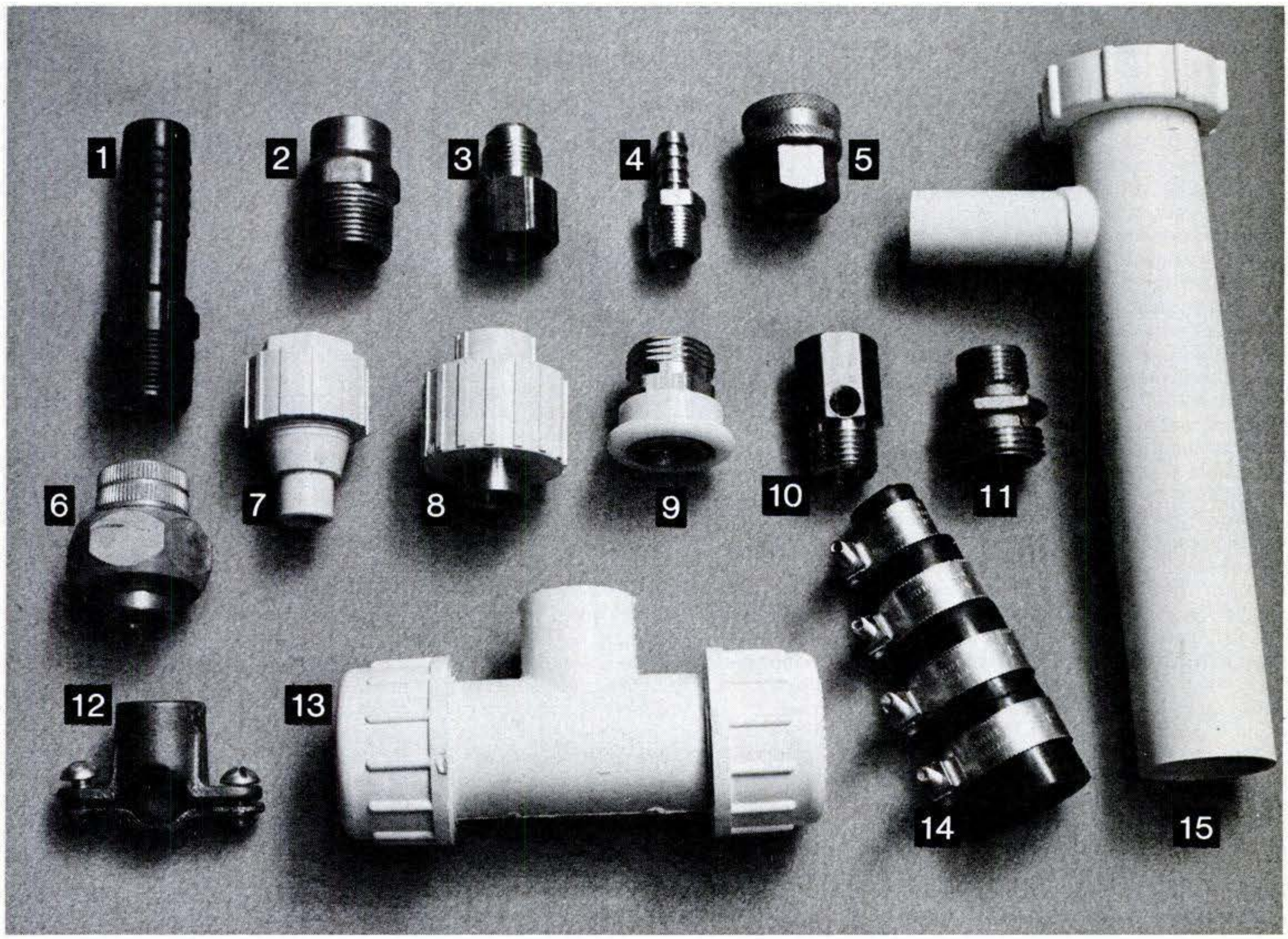
- **PVC slip-coupling tee.** This popular tee should never be connected to a hot-water-supply pipe. Polyvinyl chloride (PVC) is suited for drainage and cold pressurized water, but not for hot pressurized water. Hot water can soften PVC enough to cause a leak.

Also, plastic expands faster than metal. As soon as hot water flows, the female threads on the fitting's branch tapping expand away from a metal pipe that's threaded into them. This alone can open the joint to leaking. No plumbing code allows PVC for hot water.

Female plastic threads on a threaded metal pipe are not the best idea for cold water under pressure, either. This setup works well only with drainage fittings.

- **Celcon plastic fitting.** To use this one, you simply push the chlorinated polyvinyl chloride (CPVC) or polybutylene (PB) water-supply pipe in. The fitting holds

Continued



Pipe adapters, mostly for water-supply systems: (1) Male adapter connects female pipe threads to polyethylene cold-water pipe; (2) male sweat adapter connects female pipe threads to sweat-soldered copper pipe; (3) female flare coupling connects male pipe threads to flared copper or plastic; (4) hose nipple connects female pipe threads to rubber or vinyl tubing; (5) hose-to-pipe swivel connector joins male pipe threads to male hose threads; (6) dielectric union connects male pipe threads and sweat-soldered copper; (7) push-on, hand-tightened adapter connects polybutylene or copper pipe to a CPVC fitting; (8) transition union adapts thermoplastic pipe to metal pipe, absorbing thermal movements (prevents leaks that would otherwise occur when two different types of pipe are heated and expand at different rates); (9) one type of quick-connector that connects washing-machine- or dishwasher-hose female threads to faucet aerator; (10) tapped bushing fits female pipe threads, presents the same, and permits a ⅛-inch pipe-thread tapping for filtered drinking fountain, etc.; (11) hose nipple connects female pipe threads to female hose threads; (12) saddle-tee clamps around a drilled hole in pipe and presents female pipe threads; (13) slip-coupling tee connects sawed-off pipe ends, branches to reduced-size male pipe threads; (14) dishwasher-disposer coupling clamps over various waste pipes; (15) tailpiece for kitchen sink allows the dishwasher to drain through a common pipe.

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it. No tightening is needed—or possible. It's a great idea, except that this unique fitting material cannot stand up to the chlorine almost always present in municipal water. Chlorine causes stress cracking in Celcon. Nevertheless, this fitting is widely sold for both hot- and cold-water use.

• **Dielectric union.** When piping systems of differing metals such as galvanized steel and copper are joined, don't just use a male or female adapter. Use a dielectric union, instead. This puts an elastomeric rubber gasket between the dissimilar metals. Moreover, a plastic washer behind the union's clamping collar further breaks any electrical continuity between the two systems, greatly reducing electrolytic corrosion. The problem is especially severe with highly ionized hard water. Whether or not your plumbing code requires a dielectric union, it's a good idea to use one between dissimilar metals.

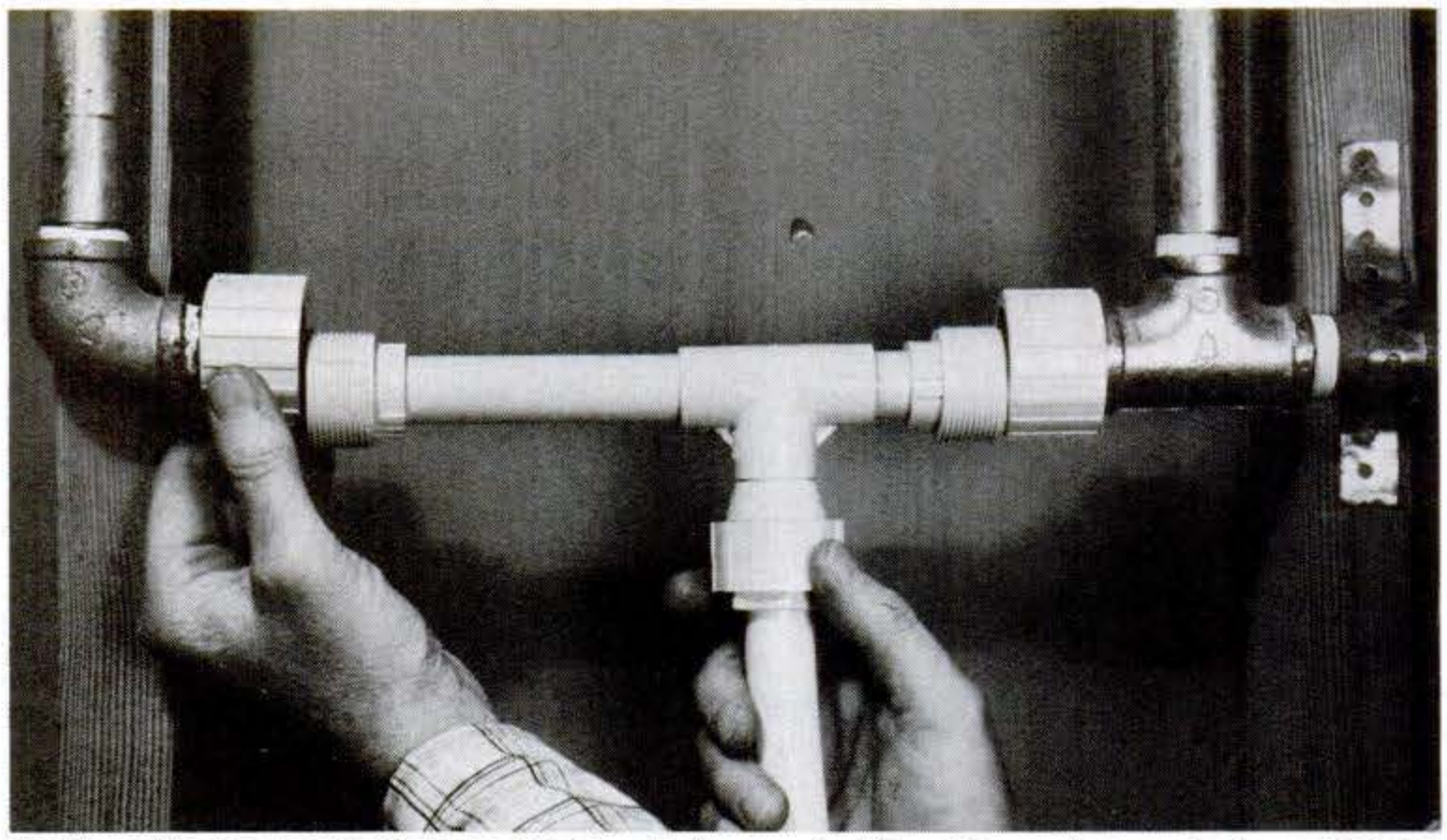
• **Transition union.** This is another type of pipe-protecting device. It gets its name from the job it does—making the transition between metal and plastic piping systems. Every time a pressurized plastic hot-cold water-supply pipe is joined to a metal one, a transition union is necessary to prevent cracks and leaks. These are caused by the previously described differing expansion-contraction rates between metal and plastic.

One type of transition union faces off the metal and plastic across a mediating elastomeric gasket, similar to a dielectric union. However, the purpose is not to break up electrical continuity but to allow for differential thermal expansion and contraction without strain or leaking.

Transition unions are mandatory in hot-water supply systems. And they're advisable in cold-water systems. They are not needed with polyethylene (PE) pipe used outdoors and in wells. Nor are they necessary for nonpressurized applications. Simpler male adapters may be installed in these cases.

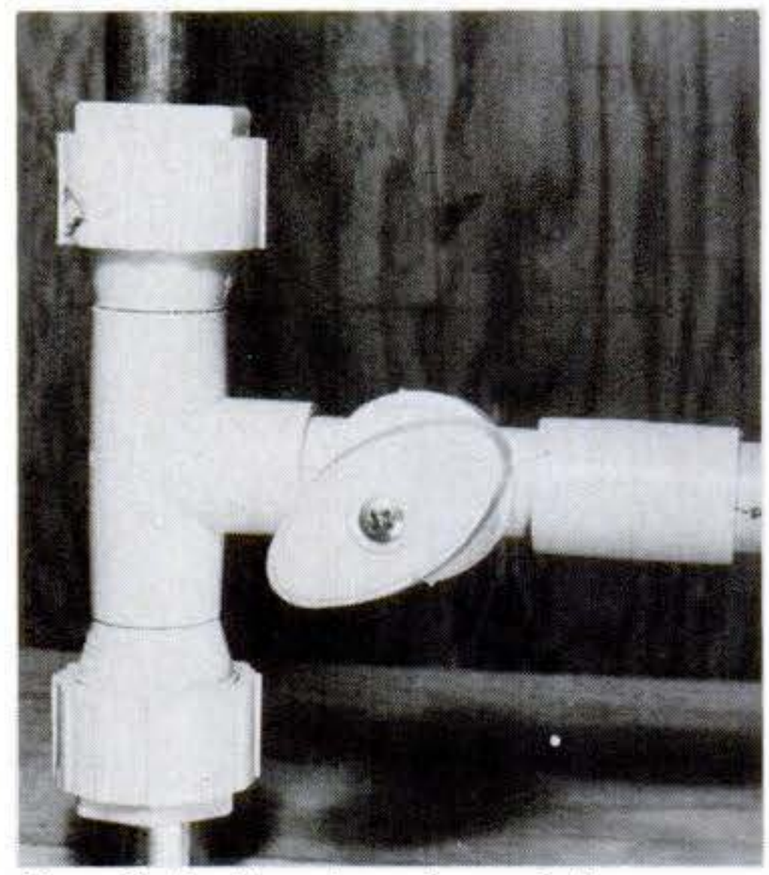
Special push-on, hand-tightened adapters, the kind that work with copper pipe as well as plastic, are also effective transition fittings. These patented fittings are designed for PB water-supply systems, enabling adaptation between flexible PB and rigid pipes. Rubber O-rings, which do the water-sealing chores, also allow for differential movement between copper and plastic.

Flare and compression fittings serve as transitions, too. They are best for small piping, such as that for humidifiers, water coolers, drinking fountains, and the like. In larger water-supply sizes they become costly. Flare and compression adapters, male or female, connect into the water-supply system. A saddle tee often has a reduced-size compression fitting for copper or vinyl tubing, along with a shut-off valve. Don't expect a small saddle tee to supply water for a garden hose, though. If you want big flow, use a slip-coupling tee (for cold water) or build a no-threading, no-soldering CPVC tap-off such as that shown in the accompanying photos. Which one you use depends on whether your house has threaded pipes or sweat-soldered copper plumbing.



No-threading thermoplastic branch in threaded hot- or cold-water system is added by cutting and removing a length of pipe, replacing it with a pair of transition unions and a tee-containing length of CPVC pipe. Here rigid CPVC has been further adapted to flexible PB.

A dielectric union should be used when connecting two pipe systems made of different materials. This will prevent corrosive pipe electrolysis. The insulated jam nut joins the two systems across a nonconductive rubber-gasketed union.



No-soldering branch can be made from a copper hot- or cold-water main with a pair of push-on, hand-tightened adapters in the copper-pipe size. Be sure they're right for copper pipe. The adapters solvent-weld to a CPVC tee. The branch run is also CPVC.

• **Garden-hose connectors.** A wide variety of adapters and quick-couplers is available. Basic, of course, is the threaded hose bibb, but where this is not available or desired, male or female hose adapters may be used. In case you haven't tried it, a garden hose connects poorly to similar-sized ¾-inch threaded pipe, both because of the tapered pipe threads and the lack of a good gasket seal on the pipe end. Hose adapters that solve this problem are made to fit either ½-inch or ¾-inch pipes and fittings. Adapters for one-inch hose are available, too.

From there, you can install quick-couplers for complete ease in moving hoses from one set to another. If your local plumbing-supplies dealer or hardware store doesn't have what you need, try a farm or irrigation-supplies dealer. Once every hose outlet, hose, and sprinkler, etc., is fitted with a male or a female quick-connector, coupling and uncoupling take only a second. It's worthwhile where many changes are necessary.

• **Male and female adapters.** The simplest of all, these cost little and work well where no bimetal or metal-vs.-plastic connection calls for something else. One end fits threaded pipes; the other fits sweat-soldered copper, nonpressurized plastic, rubber tube, or vinyl tube.

For use with polyethylene pipe, adapters threaded at one end and barbed at the other are available in either galvanized metal or plastic. The metal tends to corrode and the plastic may break under strain. Which to use depends on conditions. If the adapter is subject to vibration or strain, it's probably best to use galvanized. But if not, the plastic may outlast metal. You may have to shop around to find the type you want.

If you adapt to water-supply pipes correctly, the built-in, leak-free life of your home plumbing system will be kept intact. For that, it's well worth searching out the correct fitting.

If you encounter a problem not mentioned here, ask at your local home-care center for information or locate a plumbing-supply house and ask about the appropriate fittings to use. PS

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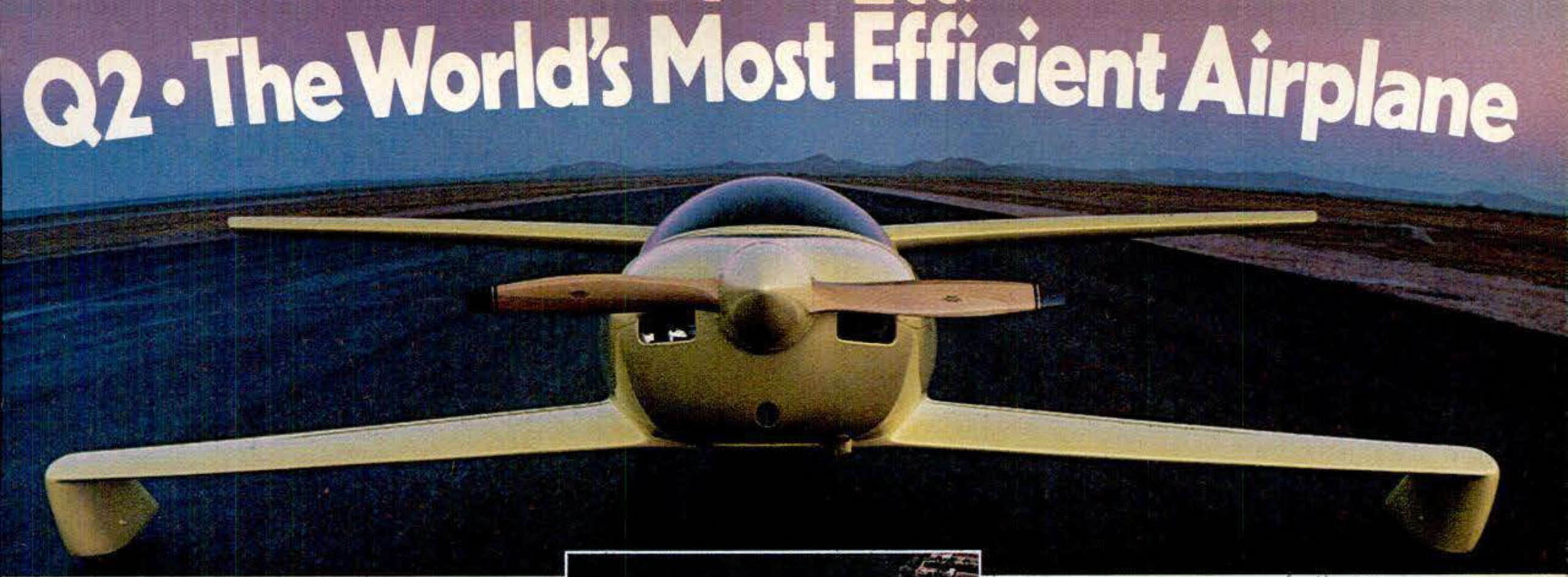

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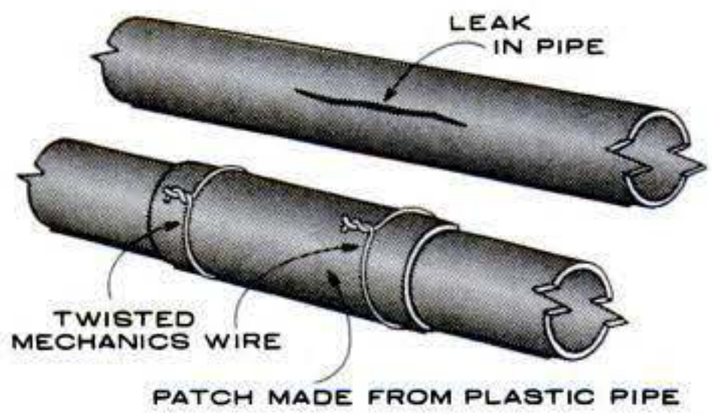
Clean the outside of the pipe and the inside of the patch with a cleaner-primer. Then liberally apply a compatible solvent cement [PS, Jan. '81] to the mating surfaces. Join them immediately, binding tightly by twisting mechanic's wire around them, as shown. The wire can be removed later, but the patch must cure for at least an hour before flow is restored.

Broken pipe? For that you need a repair coupling.—*Richard Day*



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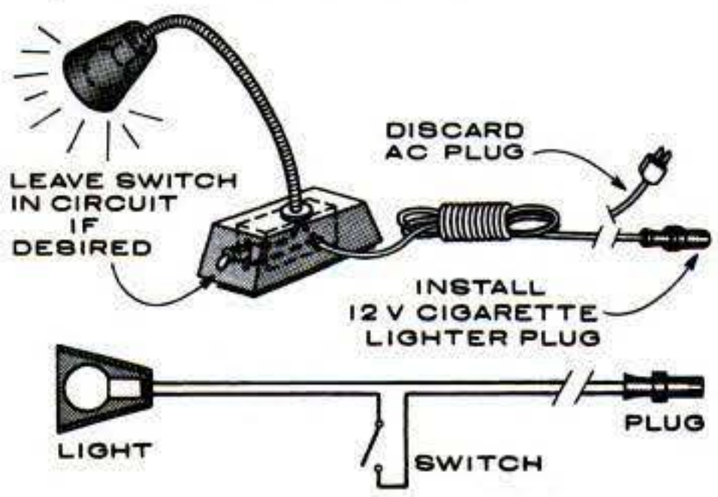
Goose-neck lamps work best; but a broken elbow-rod mechanism could be removed, leaving the light socket and reflector to form a miniature version of the drop-cord lamp used in garages.—*Morris G. Hults*



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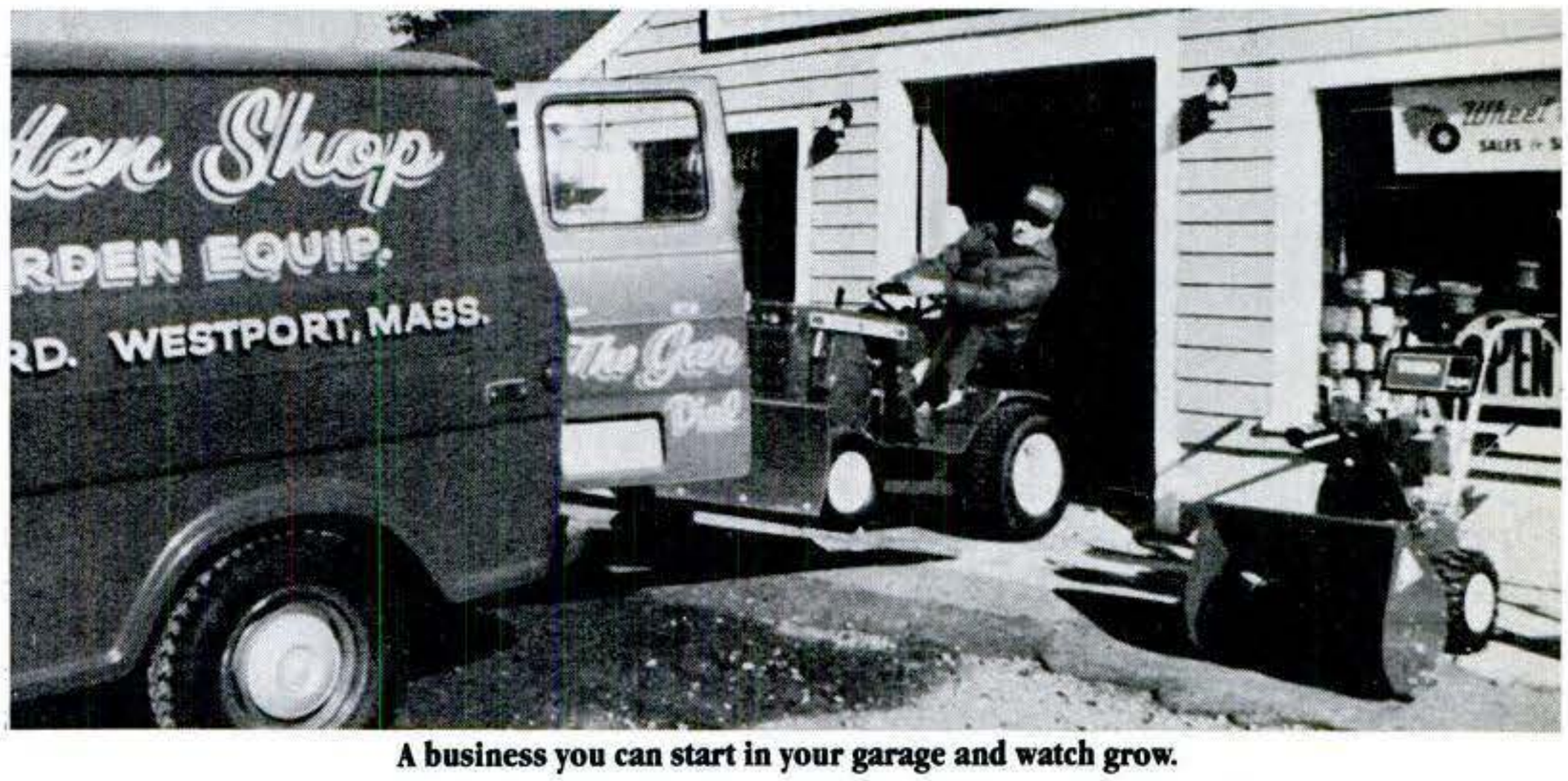

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SHOP TALK

By AL LEES

Tool rack for all seasons

I first spotted the Spanger Tool Holder at Chicago's Hardware Show and got several units to try out. Individually spring-loaded slots offer a snap-in grip for any tool with a skinny shank. I mounted mine between the shelves of a utility closet, as shown, to keep household screwdrivers, pliers, and chisels organized and handy. Tools are held securely until you tug each one free, so the racks are ideal for motor homes and boats. Since they take up so little space—and offer a variety of mounting holes—you can install them anywhere.

You'll now find the racks at Sears, True Value, and other hardware chains—and at automotive-supply stores (they're fine for keeping a graduated set of wrenches handy). And the racks are cheap: around $5 to $6 apiece.

Finish for rammed earth

Henry Levy of Flexi-Wall Systems (Box 88, Liberty, S.C. 29657) writes—in response to Rich Day's rammed-earth article of last December—that Flexi-Wall would make an ideal interior finish for rammed-earth walls. Southeast Editor Evan Powell covered Flexi-Wall for us back in September '74, and Rich Day agrees that the heavy, jute-reinforced "plaster wallpaper" could be applied directly to a rammed-earth wall without any furring or fuss. It costs about 50¢ a sq. ft., including adhesive.

Other readers share

If there's one trait of the typical PS reader that stands out above others, it's his urge to share his experience or expertise. He's the man in most neighborhoods from whom practical advice is sought—often with a request to borrow his tools or use his shop. These two letters—typical of many we receive—represent different aspects of this trait.

Lew Brumberg Jr. of Selbyville, Del., writes: "Here's a picture of the weekender sloop you ran in your March '81 issue. I sent for the plans, started the boat on March 21, and launched it on July 22. I made everything myself, including the 4×4 mast and the boom and gaff (2×4's glued together with wooden pegs). The bowsprit is from mahogany driftwood I found on the beach, and I turned the wheel spindles on my lathe. I've had many hours of enjoyment—and many compliments.

"PS is without doubt the best magazine there is for covering a wide range of subjects. I've read it for years and look forward to enjoying it for many more."

George Anderson of Staten Island, N.Y., sends this comment on my December article on slating windowsills: "You tell us that your hacksaw won't cut deep enough to notch the tile. That blade can be indexed 90 degrees in the frame to let you cut a three-in. strip to the moon!"

True enough—for most cutting jobs. Space didn't permit me to include a warning, though, that if you try this on the man-made, cement-based mineral "slate" I was using, you're likely to break even more blades than I wore out. To share *my* experience further, let me say I found the only practical way to attack this stuff was "head-on"—with the blade in line with the frame, as I showed in my photo. Other readers suggested I should have tried one of those carbide-rod cutters in the frame, and I agree *that* would have let me "cut sideways" with my hacksaw. By all means, let's keep sharing!

More about that boat

Plans for the sloop that reader Brumberg has enjoyed building and sailing are still available for $10 from Stevenson Projects, Dept. W-102, Box 585, Del Mar, Calif.

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92104. Designer Pete Stevenson writes: "I've been using my weekender a lot lately and am happier all the time with the way it goes. We kept up with a Catalina 27 for a half-hour last week, and my sloop's not designed for speed. We had three people on board, and Mr. Catalina was sailing alone!"

Pete also remains enthusiastic about his latest boat, the three-way day tripper—called the Triad—featured in last month's issue. Pete always tests his designs thoroughly and decided this one should be taken to Hawaii for that purpose. Here's what he wrote me from the "garden isle" of Kauai:

"The locals have been conditioned to think of sailboats as rich white men's toys—those big white yachts that put in here. They've never thought of using sails themselves, so it's a revelation to take them aboard and watch them stare up at the sail, down at the speeding, silent boat, then back up at the sail as the whole process starts to sink in. I'll bet by our next visit here nobody will be *paddling* a canoe!"

Yes, we know it's a trademark

We're getting such a spate of letters from corporation lawyers about our use of trademarks, I'd like to set the record straight: PS is well aware that Sheetrock is a brand of gypsum board, that Masonite is a brand of hardboard, that Filon is a brand of FRP panel. When we use these names in an article, we do so because we are identifying the specific material that we used in the project we're discussing. The fact that we always capitalize these names indicates that we recognize them as trademarks. In the past, when we used a specific product name we were likely to get a note of thanks from the manufacturer. These days we get a reprimand, instead, from some staff lawyer eager to prove that he's actively guarding his corporation's rights.

Look, fellas—I'm on *your* side. I realize you've been given this watchdog job in response to the Federal Trade Commission's recent challenge of Formica's trademark, and I agree that this was an improper act of government meddling. If Formica can suddenly be declared the generic term for plastic laminates, then Kodak could be declared the generic for fixed-focus cameras—or Xerox for all photocopiers. It's absurd and unfair to ignore the fact that these companies have expended much energy and cash developing and promoting superior products that deserve unique status. PS will always remain scrupulous about identifying brand names wherever it is a service to readers to do so. And where any of several brands will do equally well, we'll use a generic term.

In return, all we ask of you trademark lawyers is that you take the time to *read* our articles before writing. It has never been PS policy to clutter up editorial pages with all those little circled symbols signifying registered trademarks and copyrights; but we always cap a product name when we're talking about a specific brand. To complain to us about such use is to waste your time, and ours. PS

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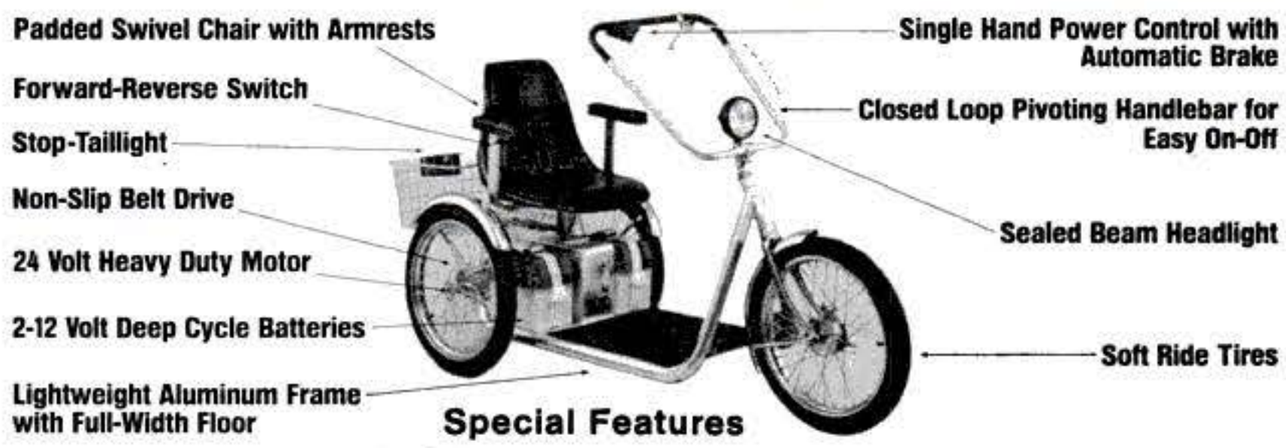
Maria Weigand, 13, Lebanon, NJ



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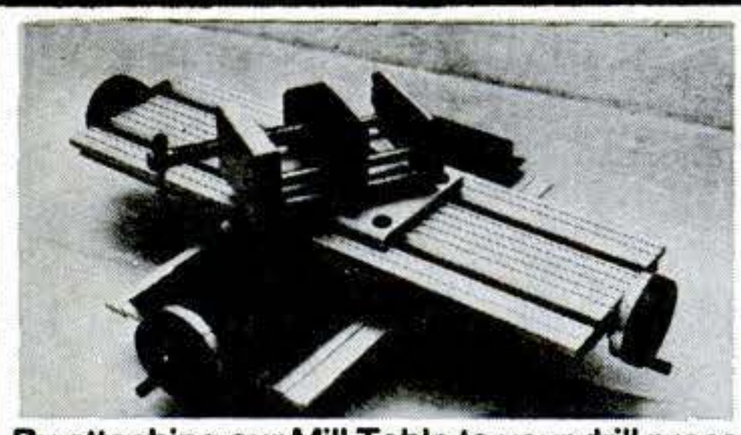

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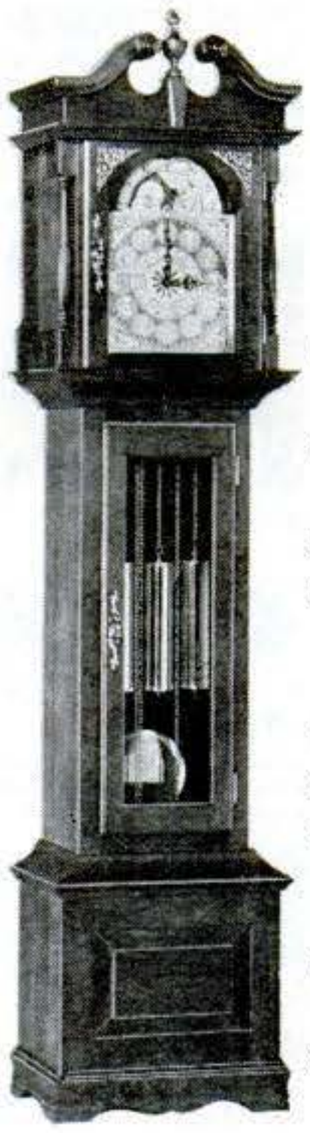

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Dome home

[Continued from page 68]

Railoc Company, makers of modular silo components. Railoc's silo roofs come in diameters from eight to 32 feet, in one-foot increments. The roof sheets—the strips that you bolt together—are all two feet wide at the bottom. Their curvature and length change, of course, with roof size. At sizes over 20 feet, the sheets come in two pieces, a top and bottom. They slide into each other and interlock—no caulking needed. And they're waterproof.

"It doesn't take any skill to put up a basic roof," Jantzen says. But making the cutouts takes advanced skills—or a good contractor. Somewhere up ahead, Jantzen sees a complete modular dome system "with everything precut and predrilled, a sort of kit."

His dome clusters provide 1,640 sq. ft. of space, plus 236 sq. ft. of outside storage. (That's the storage unit—labeled "pantry" in our drawing. It will be the subject of a future PS article.) With the R-46 insulation, he needs little air conditioning or heating. "Last summer," Jantzen says, "our inside temperature never went over 78 degrees, and that was on a 100-degree-F day." For heating, he has a small airtight wood stove, but has used it very little. His major problem so far: excess humidity.

It all seems to work, but still, says Jantzen, "As a designer, I regard this house as an experiment in developing one kind of space container." As part of that experiment, he and a friend, Dr. George A. Lager, a crystallographer and assistant professor of geology at the University of Louisville, have buried sensors in the floors and walls to monitor heat flow. These have been hooked up to a computer—as will, later on, other sensors to monitor light intensity, sound levels, humidity, and other information.

From this they expect to develop a computer model that will simulate the internal environment of a dome in responding not only to its construction features, but also to such factors as season, climate, and outside temperature.

"Eventually," says Jantzen, "we'd like to develop a program in which the customer would talk to a computer." You'd tell the computer where you expected to put the house and about your family and life style, and the computer would tell you what kind of dome home you needed: size, relationship of dome elements, site orientation. "It would make all the important decisions for you," Jantzen says. PS

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Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the **most advanced security system available for consumer use.** With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

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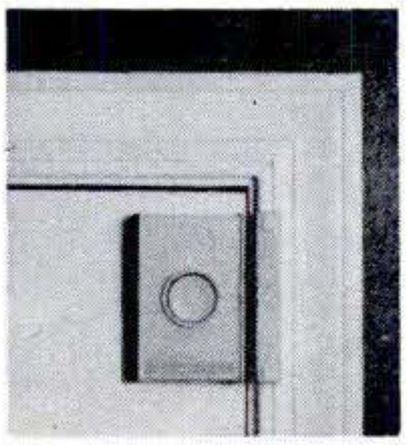
HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for 10 minutes and scaring away the intruder, the system shuts off automatically and resets itself.



This photo shows a transmitter & magnet installed. If a break-in attempt occurs, the transmitter and magnet become separated triggering a wireless radio signal which activates the alarm. Installation takes only a few minutes and doesn't even require a screwdriver.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2½ second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is **highly resistant to false alarms because it is not sensitive to motion or sound.** Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack— all without setting off an alarm.

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There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's EXTRA PROTECTION DESIGN lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost $2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to $200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines **pre-entry** protection with micro-electronic circuitry to provide the most protection at the lowest cost.

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The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a **burglary protection device,** a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

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Ceramic engines

[Continued from page 66]

In a turbine engine this disc picks up exhaust heat and gives it back to incoming compressor air. The material has about 1,400 air cells per square inch, and the regenerator spins at a leisurely 20 rpm. Exhaust gas heats half the inside surface while compressor air passes through the other half from the opposite side before being mixed with fuel.

"A disc operates with one surface at about 200 degrees C and the other at 1,000 to 1,200 degrees—all within a space of about three inches. You need materials with low thermal expansion," said John Lanning, Corning's director of advanced engine development.

"This will run in an idling engine with a thermal efficiency of about 97 percent," Lanning said, tapping a disc.

Lanning recalled a major problem that arose early in the development of this key engine component. Regenerators were being tested in vehicles on the East Coast, using fuel with moderate sulfur content. "Ford took some truck turbine engines out to Arizona and began to run them on their test track with West Coast fuel, which had almost double the sulfur," said Lanning. Cracks appeared in the discs. "We had been running 1,500 to 1,600 hours," he said. "Suddenly we were getting failures in 50 to 100 hours." The cause: sulfuric acid was condensing on discs. High temperature enabled hydrogen ions in the acid to exchange with lithium ions in the LAS material. That produced a different thermal expansion in part of the core. "We were up against the wall," Lanning said.

The solution was the invention of a new material for the discs by David Grossman, a Corning lab researcher. "My thinking was that we could preempt the reaction—allow it to go in a controllable situation," he said. He devised an additional step in the manufacturing process in which acid leaches the lithium from LAS.

White-hot turbines

Look into a turbine test rig at Ford's lab and you'll appreciate why it's tough developing internal parts for these new engines. A computerized console cycles components under test rapidly up and down between 1,600 degrees and 2,500 degrees F in a roaring plume of hot gas. Parts glow red, then white-hot, then red again, simulating driving a turbine car. "It can really kick the ceramic parts with thermal shocks," says Ford engineer Bob Baker.

And the white-hot power turbine must hold together while spinning at an incredible 100,000 rpm. When a part in a metal-based turbine fails, bent pieces can later be analyzed. "But if something goes wrong with ceramics," says Baker, "you'll wind up with something between sand and little rocks." He produced plastic bags of flintlike, marble-size chunks—remains of ceramic components whirled to destruction in tests.

Engineers must ensure that parts are reliable before a complete ceramic turbine is tested. Failure of one component in the high-speed turbulence can shatter them all.

Ford worked on a 200-hp turbine in the 1970's and is now making some components for the Garrett (Phoenix, Ariz.) AGT101 gas-turbine program.

The Garrett-Ford project and a similar federally funded GM program call for compact, 100-hp turbine engines capable of powering 3,000-pound cars at 43 mpg. Garrett plans to run an assembled engine early this year, but with metal components at reduced temperatures. A year later an all-ceramic AGT101 will be fired up.

Prototype vehicles? Some may be ready here before 1985, but European firms could win the race. Experts believe it will be the 1990's before U.S. turbine production could begin—assuming prototypes prove themselves.

Ceramics and auto industry people, for competitive reasons, are less talkative about near-term use of ceramics in piston-engine cars. "We are working to apply ceramics to the diesel engine," was all Ford's McClean would say. Many vehicle firms worldwide have ceramic-diesel projects.

Cummins Engine Co. (Columbus, Ind.), along with the Army's tank command, has been boosting the efficiency of standard diesel engines by coating pistons, cylinder-head liners, valve-train components, and exhaust ports with ceramics to retain heat, then eliminating the cooling system. For big truck or tank engines, Cummins taps exhaust gas with one turbine wheel to drive a turbocharger compressor; a second turbine is geared to the engine crankshaft.

This technique wrings the most work from exhaust heat, but may prove too costly for passenger cars. However ceramics are applied to engines, they'll first have to prove their reliability on test tracks. PS

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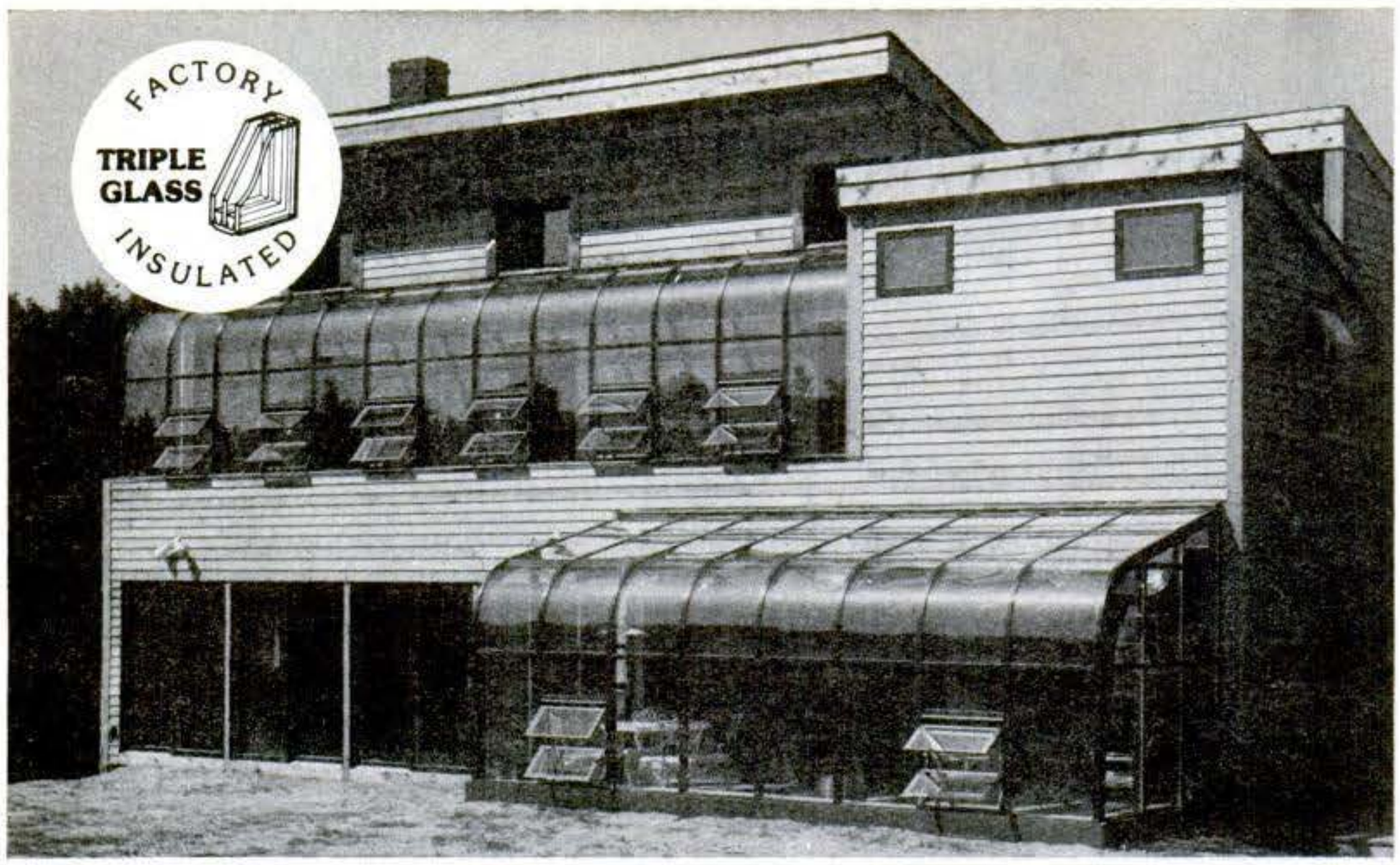

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Battle of the blade brakes

[Continued from page 81]

setting—normally the START position.

Mower manufacturers, however, are wary about the sustained reliability of mechanisms that must disengage the engine and engage the brake in a fraction of a second—and do it tirelessly over the life of the machine. But clutch-brake makers claim that extensive field testing shoots down such fears. Joe Sparma of Worthington showed me a fat file of questionnaires returned from test-mower users. Only a few claimed to have had troubles with the systems.

Engine condition, however, could prove to be a problem with clutch brakes, just as with zone start. When the bail is released, a swift response from the engine, governor, and carburetor is needed to avoid killing the engine. If something goes wrong, both the engine and blade stop turning. Judging from experience, this will not be a major hurdle. Engine designs have progressed to a point of high reliability—they simply start and run dependably. But my own tests showed that a slightly larger four-hp engine handled the brake action better than the smaller 3.5-hp.

Despite the need for the engine to be in good condition, I found clutch brakes far more convenient than constantly stopping and restarting the engine. Partly, though, the degree of convenience depended on the type of clutch-brake control on the handle. Surprisingly, the mower makers buy these handles and cables from independent vendors, not from the clutch-brake builders.

With some controls, engaging the mower-blade clutch reminds me of setting a mousetrap. There is substantial spring pressure to overcome, and if you don't do it right, the handle whacks back hard on your fingers. But another control, this one on an MTD mower made for Montgomery Ward, works slickly and easily. The MTD clutch brake works well, too. Since, as Toro's Fanning says, "few buyers are going to look at what's under the deck, but are going to be concerned about the control systems," I'd suggest that you actually try the controls before you buy. They might be more difficult to operate than some members of your family can manage.

You should also be aware that all three systems, electric restart, zone start, and clutch brakes, are just getting their first real public trials. There's no question that all three systems will evolve and be modified over the next few years. PS

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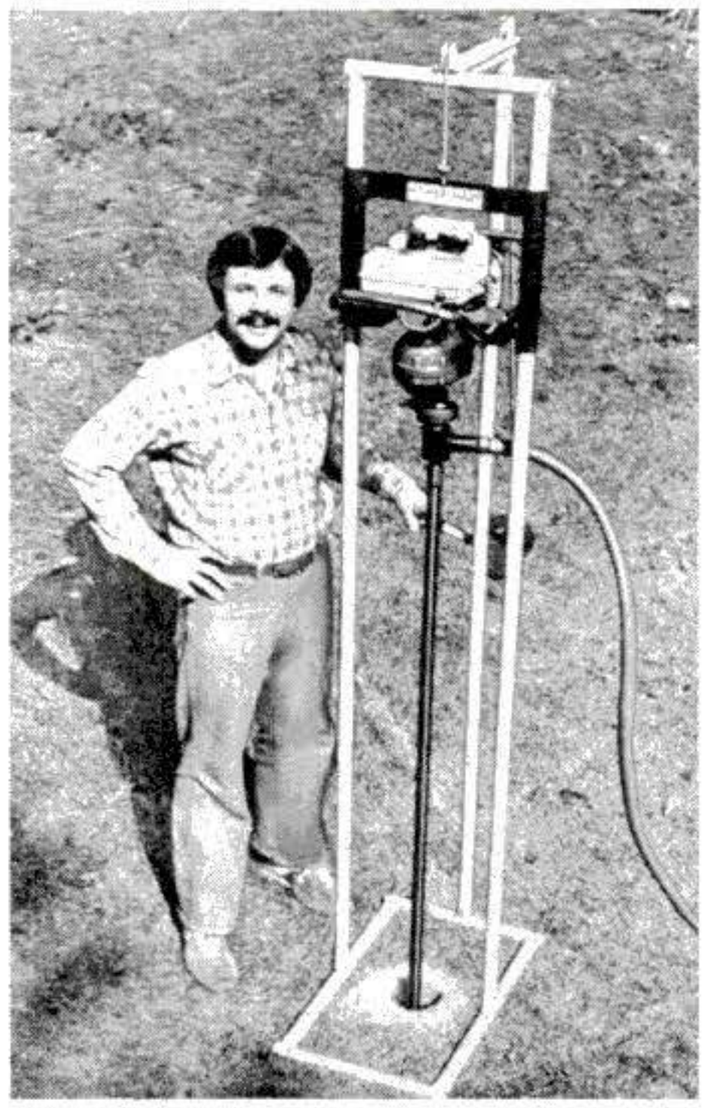

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De Lorean

[Continued from page 93]

During testing we noted that the car's famous stainless-steel body picked up all kinds of markings, from fingerprints to the imprints of blue-jeans pockets. (Moral: Wear white gloves and don't sit on the fenders.) This problem was anticipated by De Lorean, and there are special instructions on care and treatment of the stainless-steel skin in the owner's manual.

When was the last time you drove a car with smaller wheels in front than in the rear? The De Lorean has them—14-inch wheels in front and 15-inch on the rear. Balance and handling are the primary reasons for this unorthodox feature.

The De Lorean is EPA-rated at 29 highway and 19 city, but performance is what sports cars are all about. We found the car surprisingly quick. Surprising, because the 2.8-liter V6 engine seems small for this 2,750-lb. car. Our 10.6-second average for 0-60 mph acceleration doesn't quite match the fastest sports cars tested in our December '81 issue, but it's not exactly leisurely, either. (Zero-to-60 times in that test ranged from 8.4 seconds for Chevrolet Corvette to 11.8 seconds for the Mazda RX-7.)

The five-speed transmission does let you get the most out of the engine, but it tends to be balky. Speed shifting from first to second was too quick for the transmission's synchronizer and caused some gear clash. The location of the shift lever is another of the car's unusual features. It's perched atop an unusually high center console. That's all right, but it takes some getting used to.

Unfortunately, while the De Lorean undoubtedly has exceptionally high steady-state cornering limits, our car darted in quick maneuvers and twitched unnervingly with every bump and road-camber change—especially in the rain.

One of the best measures of the balance in a car's chassis is how it reacts when the brakes are spiked to a point just short of lockup. The De Lorean's brakes work reasonably well, but the car's tail tends to swing out at times. Let up on the brake pedal momentarily and nudge the steering wheel, however, and you're quickly back on a straight line.

Overall, we found, the De Lorean feels tight, is responsive to its slightly heavy manual steering, and is fairly quiet at highway speeds—all features those buying $25,000 sports cars will appreciate.

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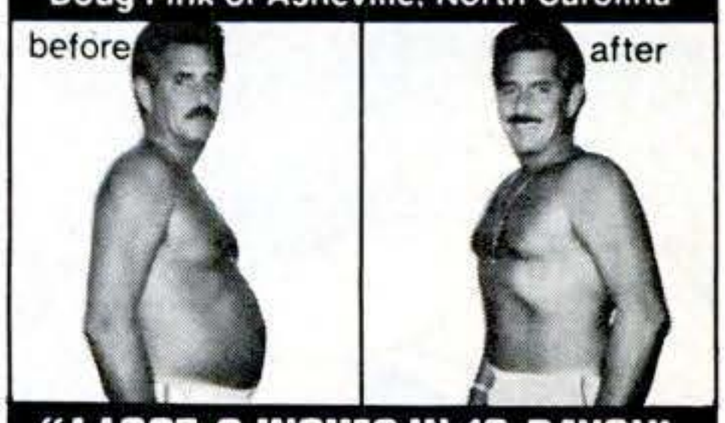

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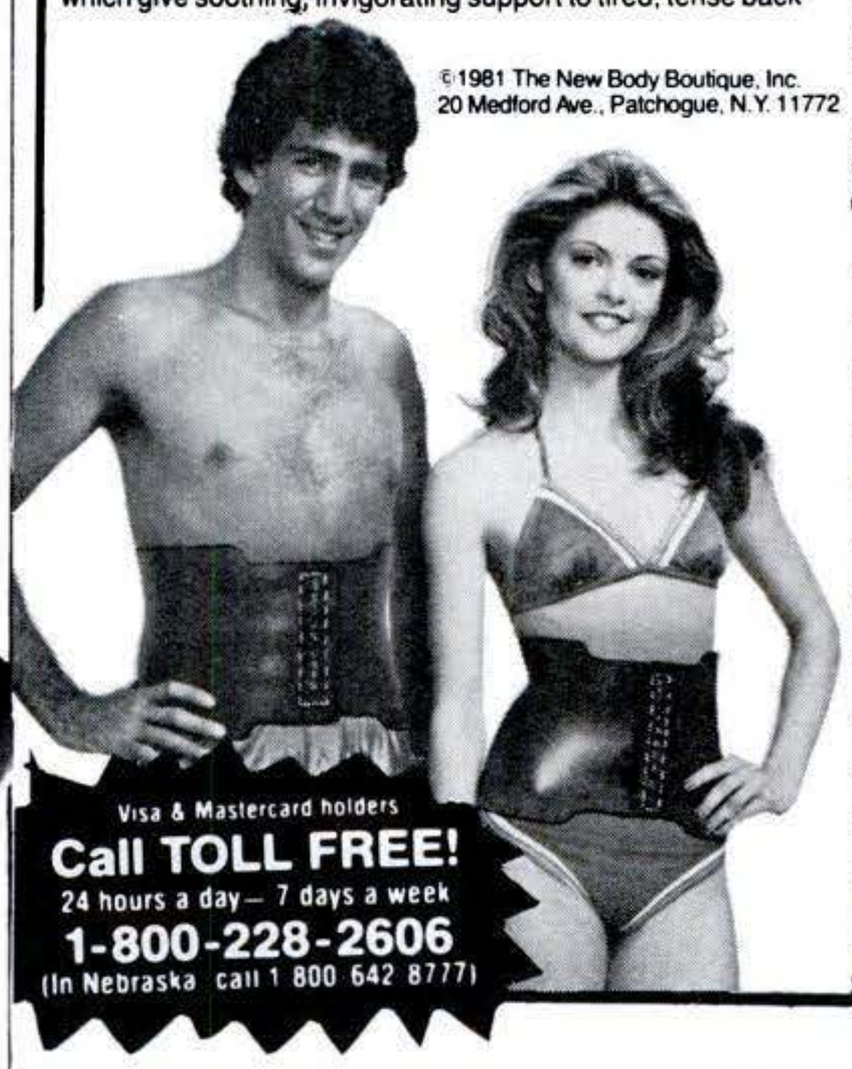

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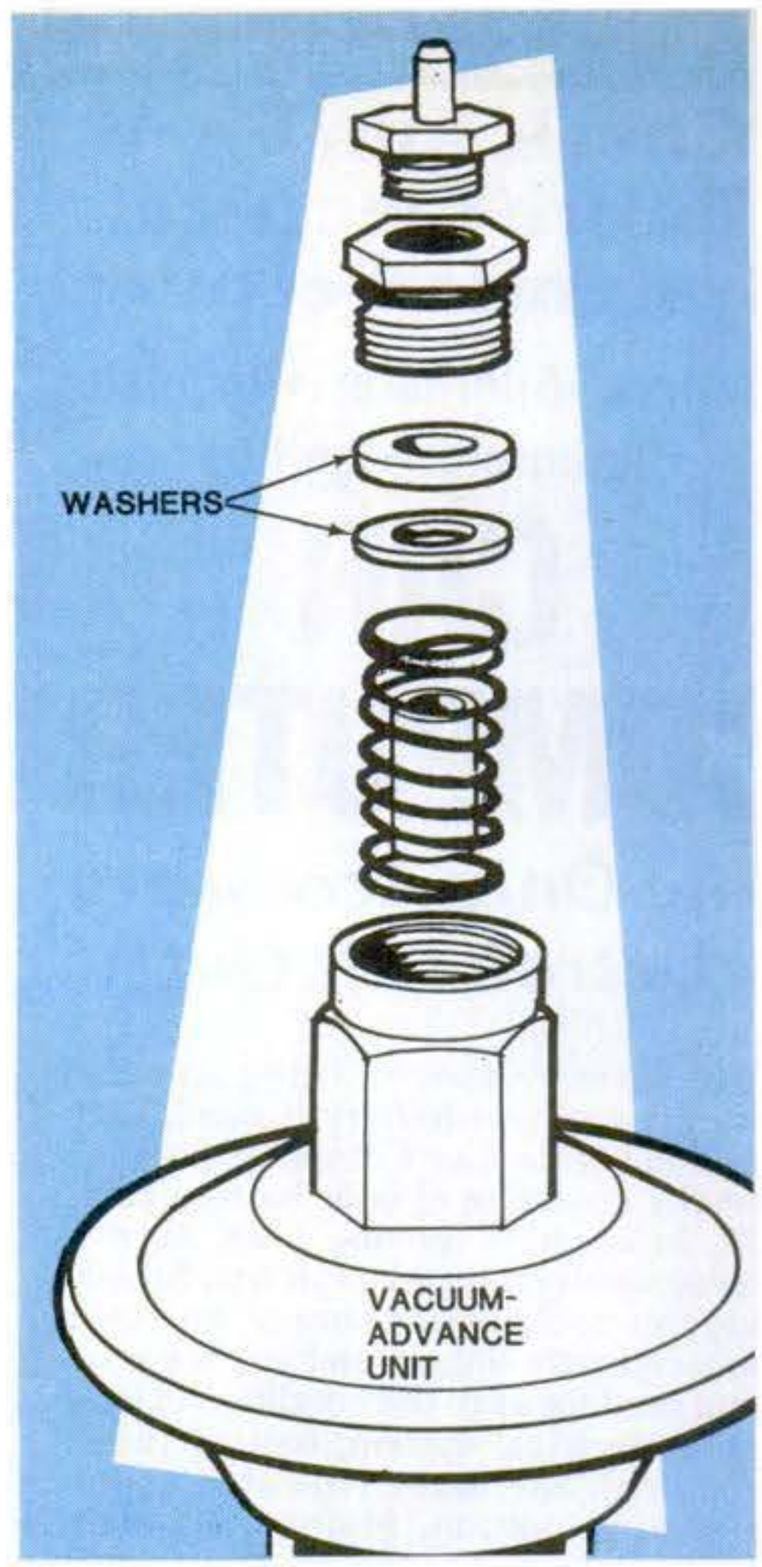
TAKING CARE OF YOUR CAR

By RAY HILL

Got a useful car tip? Send it (with Social Security No.) to Car Care, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. We'll pay $50 for each tip used. In case of duplication, earliest postmark wins. Tips can't be returned.

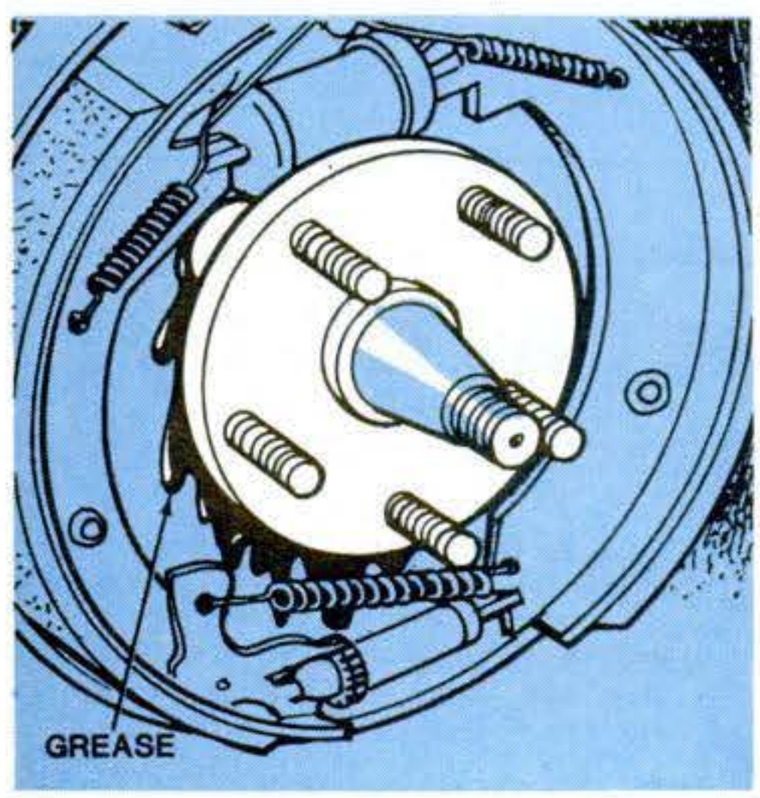
Easy way to check mechanical and vacuum advance

For top performance and mileage, it's important that your car's ignition-advance systems (vacuum and centrifugal) work properly. Here's an easy way to check them. Set basic ignition timing to spec using your timing light. After you disconnect and plug the vacuum line to the vacuum advance, have a friend accelerate the engine to 2,000 rpm while you watch the timing marks with your timing light. The timing marks should advance. This indicates the centrifugal advance is working. With the engine still running at 2,000 rpm, reconnect the vacuum-advance hose. The timing marks should advance still more, indicating the vacuum advance is working. If either system is faulty, determine why. If your car is one of the few that has a switch in the vacuum line between the vacuum advance and the carburetor base, look in a shop manual for procedures on checking mechanical and vacuum advance.



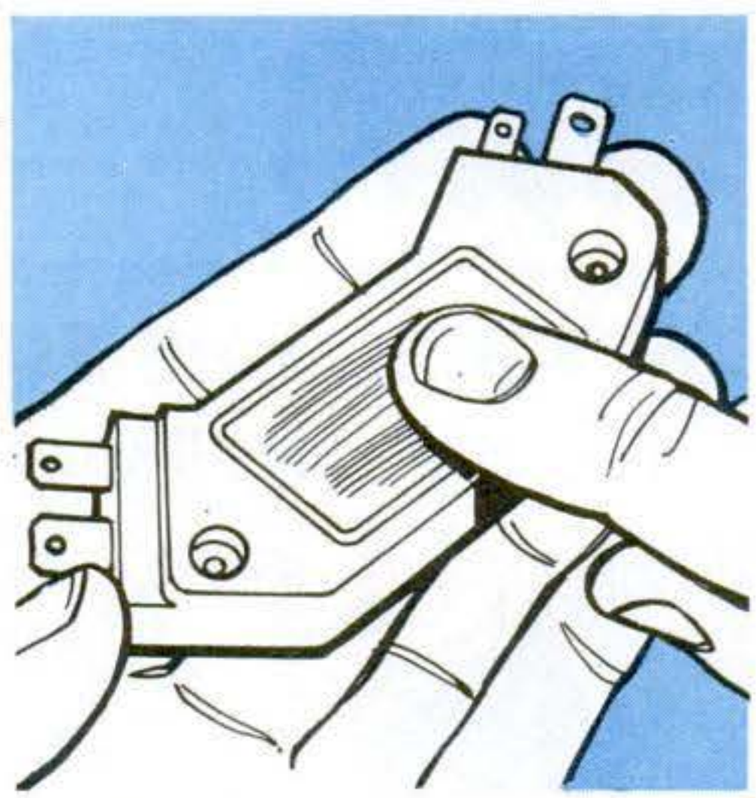
Replacing a vacuum advance

With some distributors, the vacuum-advance unit is replaced as a single piece if it goes bad. With others, the return spring from the old unit must be removed and used with the new unit. If yours is one of these, be sure that any washers or spacers accompanying the spring are transferred to the new unit. Omitting these items can result in the ignition timing advancing too quickly, as well as too much advance at high vacuum.



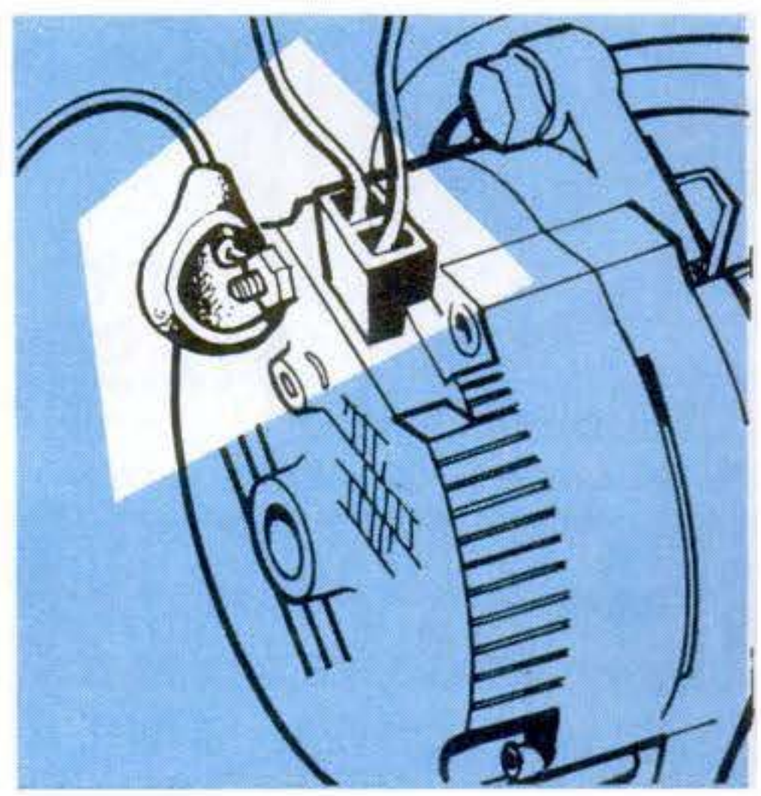
Leaking axle seal

When replacing brakes on rear-wheel-drive cars, inspect each backing plate to see if axle lube is leaking out. If it is, the lube can get on the new shoes and cause problems. Remove the axle and replace the worn or damaged seal(s). Don't forget to refill the differential.



Installing an HEI module

When replacing a GM HEI module in the distributor, apply a thin film of silicone dielectric compound to the back of the module. This ensures that the module is grounded properly. It also allows maximum heat transfer from the module to the heat sink it is attached to.



Check electrical connections

Charging-system problems are sometimes caused by dirty or poorly connected wires. Inspect the wires at the alternator and regulator by pulling back the insulating covers. If they are the quick-disconnect type, unplug and inspect them. Remove any corrosion.

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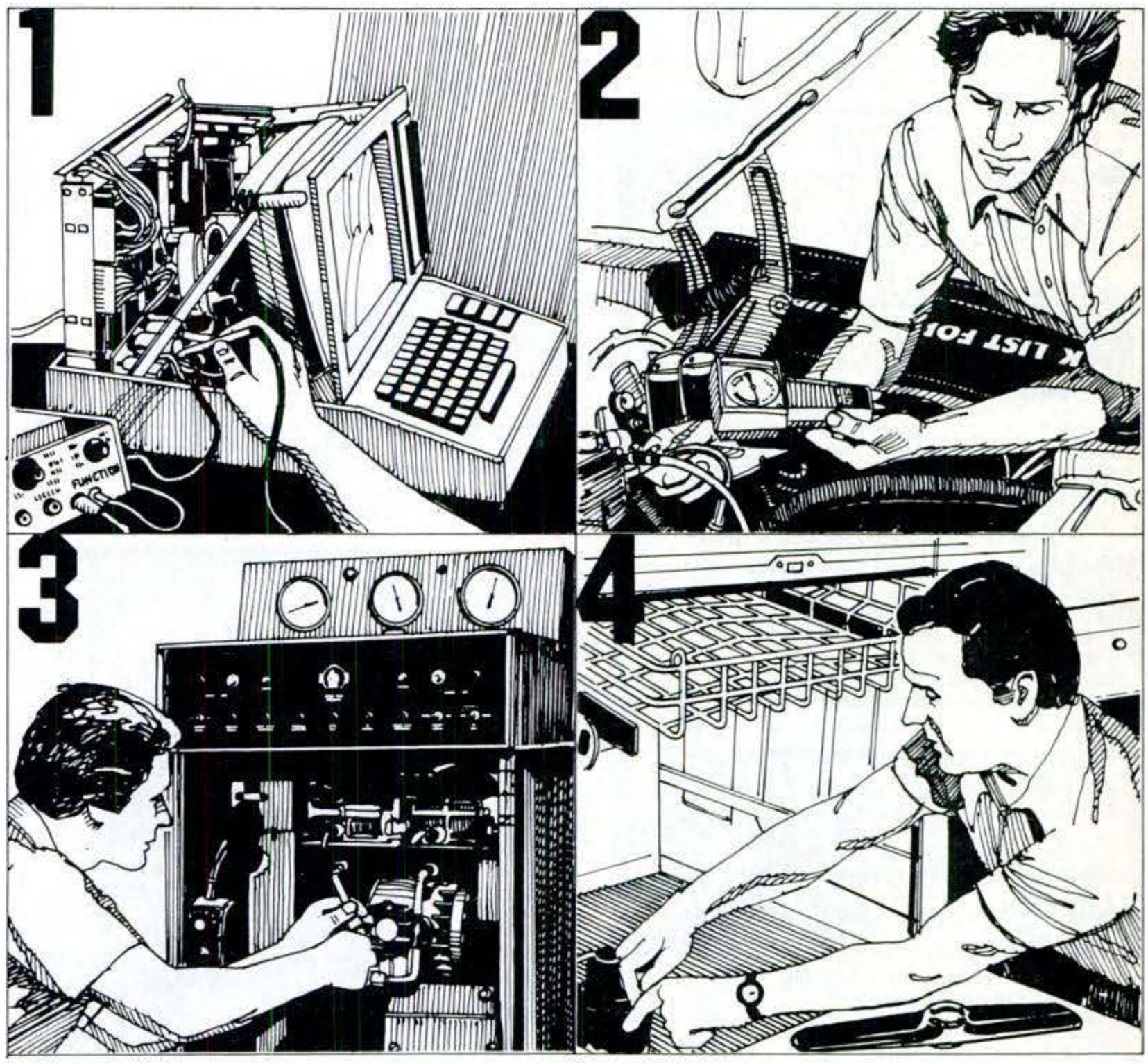

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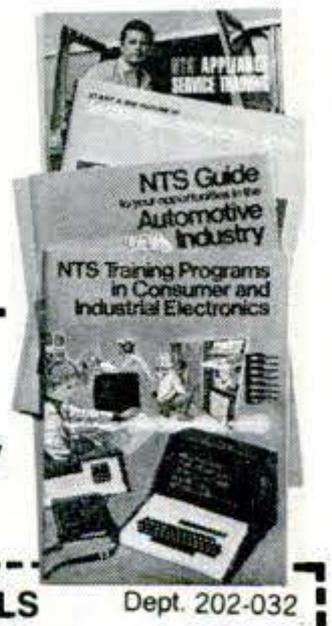

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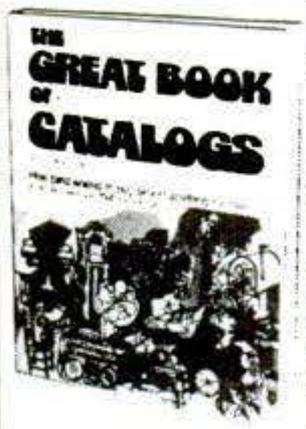

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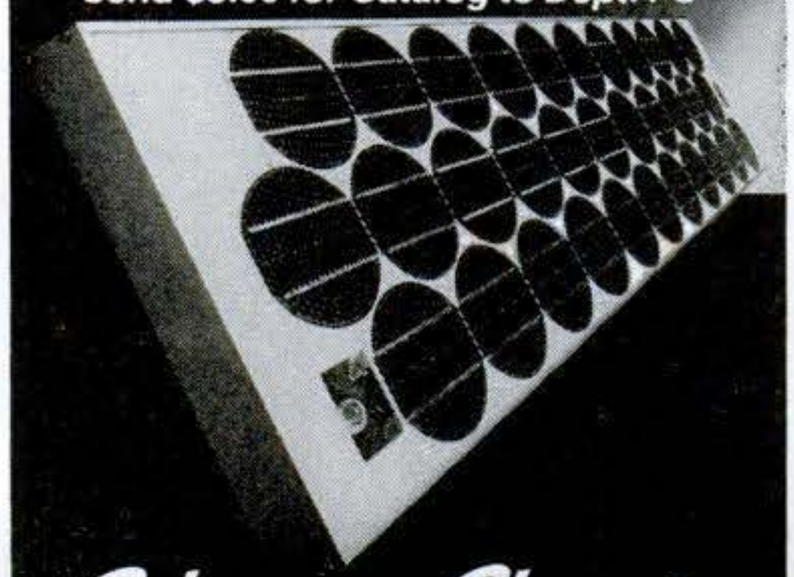

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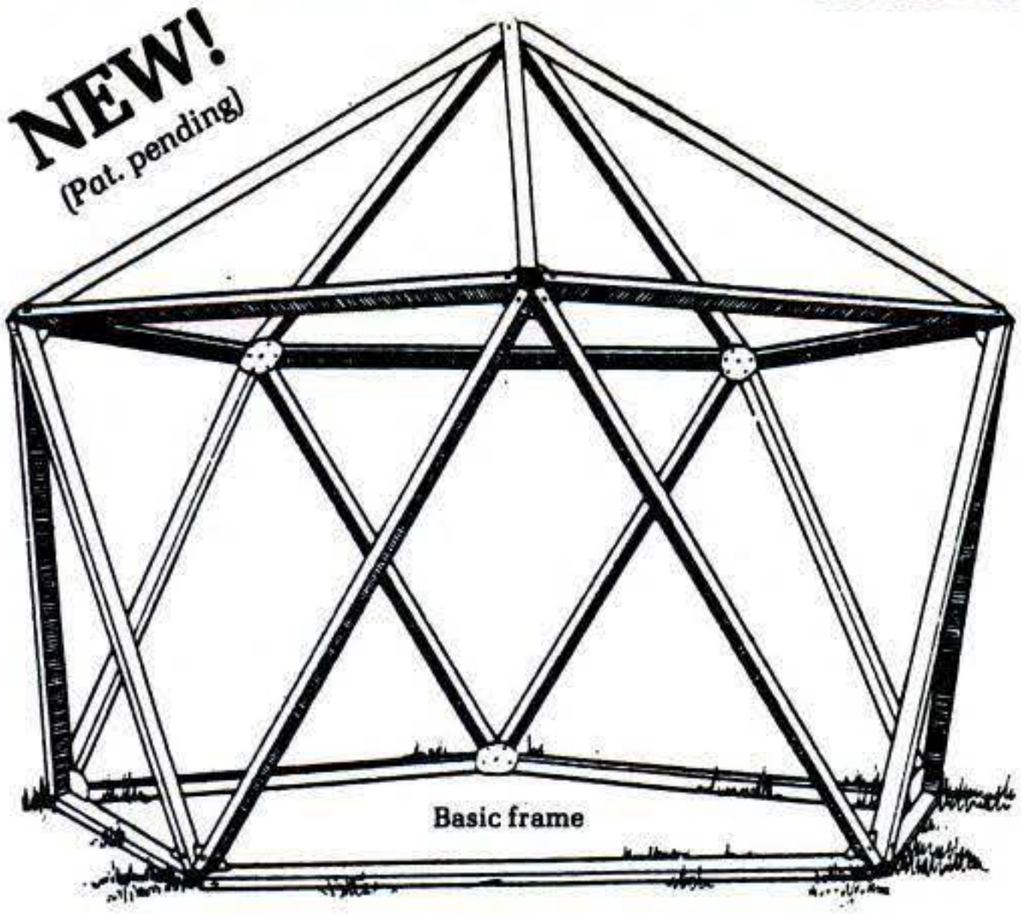

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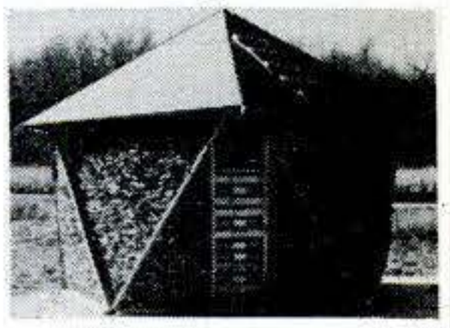

1300 Bushel Corncrib

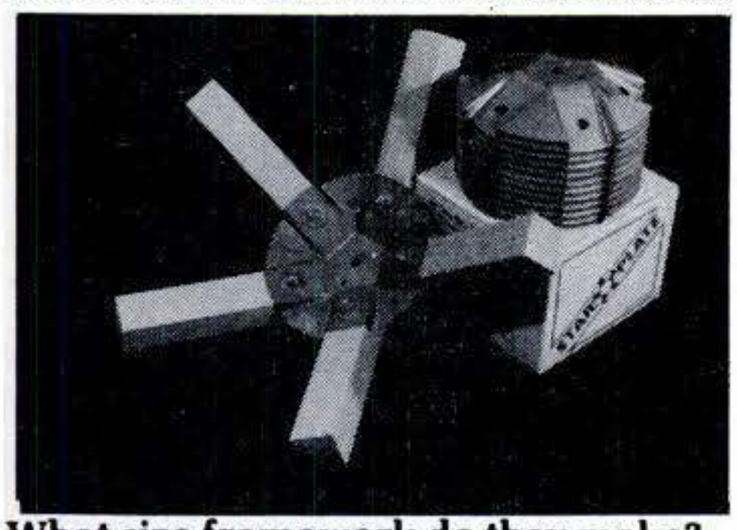
Build the frame in under two hours! Simply drill 50 holes and bolt your 2x4's to STAR*PLATES. Then, enclose it to make any small building you want.

What small building would improve <u>your</u> property?

Build it better, easier, and cheaper, with STAR*PLATE Frame Connectors!

What are STAR*PLATES?

They're heavy gauge steel plates with channels to hold 2 x 2's, 2 x 3's or 2 x 4's, so they can be bolted together to make a basic geometric framework. It takes one set of eleven STAR*PLATES for each framework.



What size framework do they make?

Any size you want. STAR*PLATES hold 25 equal-length struts together. If the struts are short, say 2-3 feet, you've built something small like a dog house or small playhouse. If they're 9 feet long, you've built yourself a greenhouse or back-40 hideaway. The framework is made of 15 triangles, all exactly the same.

Is it hard to build?

Not at all. To build the frame, you only have to drill 50 holes, and bolt the struts to the STAR*PLATES with 5/16 in. carriage bolts. The only tools required are a saw, a drill, and a wrench. It's much simpler than conventional framing. For a roof and walls, or even a floor, our plans (included with each set) give you cutting patterns and tips to make it easy.

How can I finish it off?

Any way you want to. Some STAR*PLATE buildings are elaborate, with shingled roofs, clapboard sides, and fancy doors and windows. Others are merely covered with canvas and used as beach cabanas, or with plastic to make greenhouses. One customer told us he was going to thatch his with palm leaves! You can make it as plain or as fancy as you want to.

Could I build a full-size geodesic dome house?

No. STAR*PLATES are designed for smaller structures. We recommend a maximum strut length of 9 feet. That makes a structure 13 feet high and about 14 feet in diameter, with a floor area of 140 square feet.

How can I get a set of STAR*PLATES?

Order them from The Countryside General Store, Waterloo, Wisconsin 53594, for only $39.95, postpaid. Phone orders are welcome (414/478-2139) and you can use your Visa or MasterCard.

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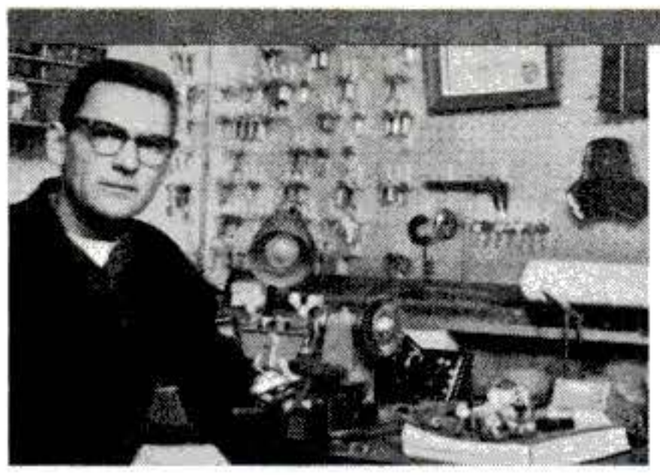

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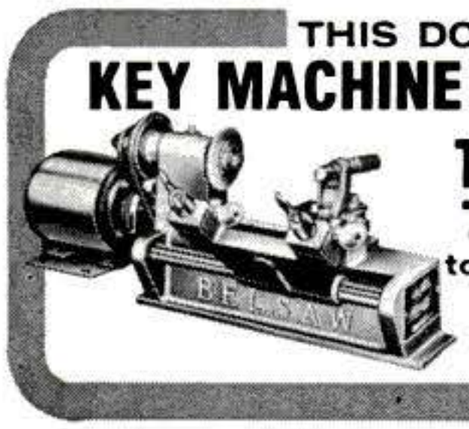

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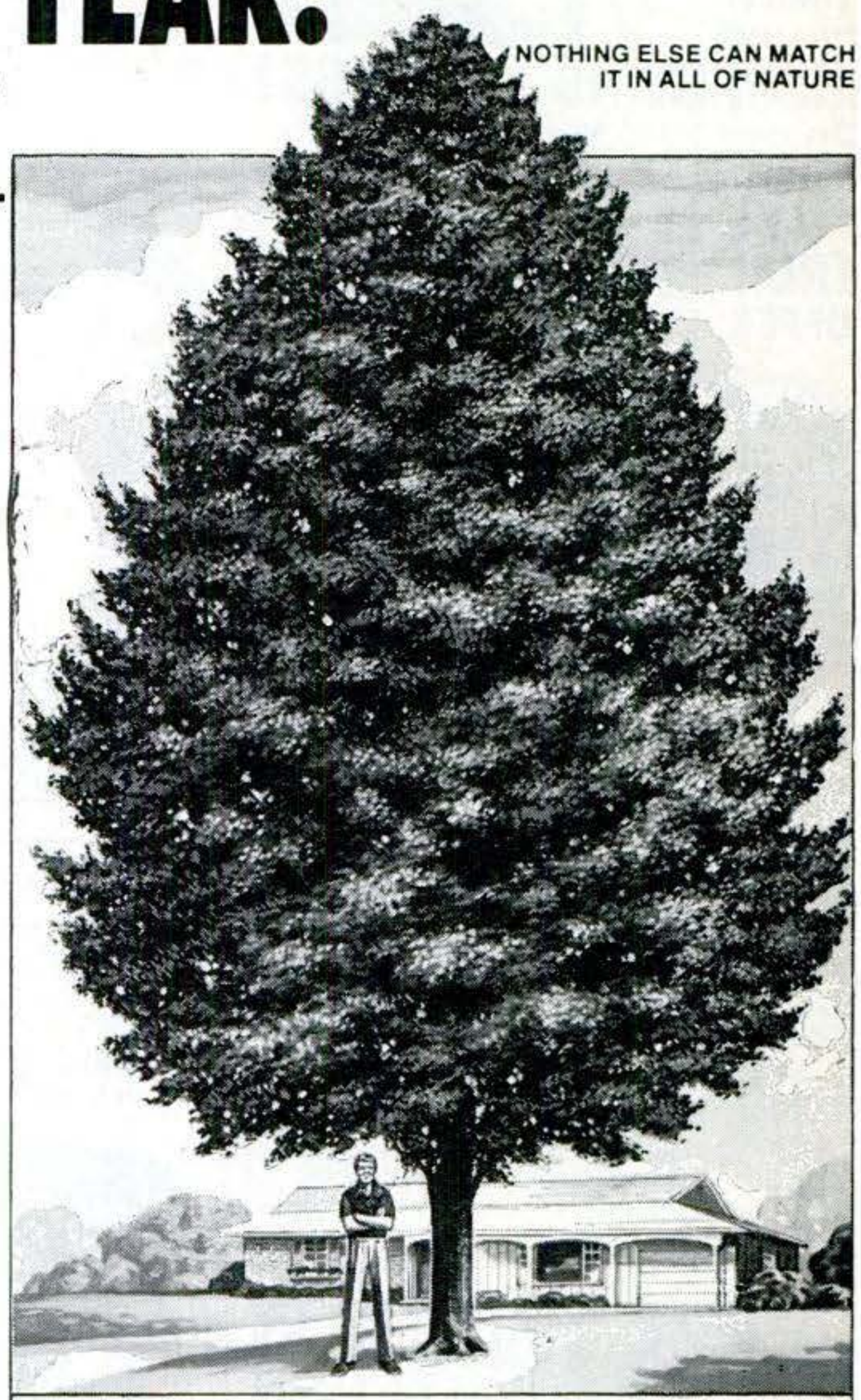

Grows More in One Month Than Most Other Shade Trees Grow in An Entire Year—More in One Season Than Ordinary Shade Trees Grow in 2 Years, 3 Years or Even 5 Years! (Illustration shows magnificent size, spread and beauty of mature Populus hybrid-fam. Salicaceae.)

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Yes! Based on amazing growth rates reported by plant scientists—it grows SO FAST ... arches out SO WIDE ... you can actually take a ruler and measure the incredible difference in height every 2 to 3 days! OR, to really leave your neighbors gasping in awe and wonder, give them a yardstick and let them measure the difference IN FEET every 2 to 3 weeks!

Yes, goes on to thrust itself so high, so fast that it actually towers over even a Japanese Red Maple, Cherry Tree or even the most graceful silky willow in such a ridiculously short time you will simply refuse to believe your eyes! Think of it!

GROWS MORE IN JUST ONE MONTH THAN MOST TREES GROW IN ENTIRE YEAR!

Because according to plant experts, Govt. scientists and Botanical Gardens who researched this wonder-hybrid ... once established, you merely water it once-a-week, and be absolutely floored as, during its SUPER-SOARING growing season, it GROWS AS MUCH AS A FULL ½-FOOT WEEKLY AFTER EVERY TIME YOU WATER IT!

That's right! Grows higher than even a full grown Flowering Dogwood IN JUST ONE SINGLE SEASON! Grows higher than even a full-grown Star Magnolia IN JUST ONE SINGLE YEAR!

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GROWS IN VIRTUALLY ANY SOIL —REQUIRES NO SPECIAL CARE— SOARS INTO A MASTERPIECE OF BEAUTY IN JUST A MATTER OF MONTHS!

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VITAL STATISTICS FROM LEADING EXPERTS

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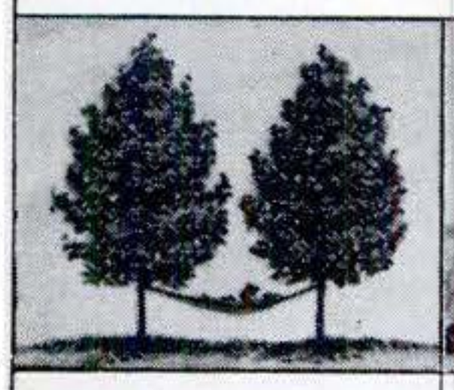
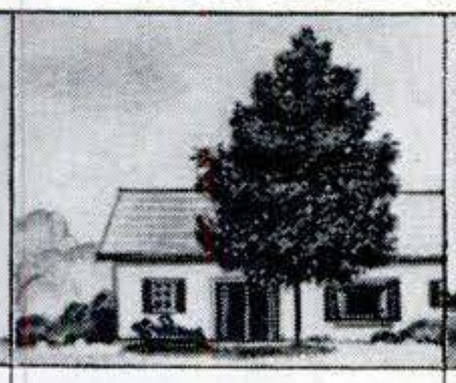
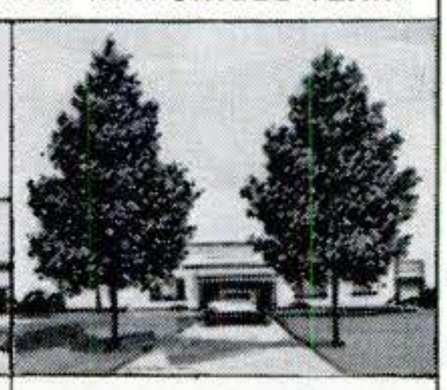


Here's a luxurious sight you don't have to wait half a lifetime growing—a matched pair of these towering show-pieces.



Picture your patio bathed in the cool beauty of this show-stopping miracle tree from early spring to the first snows of winter.



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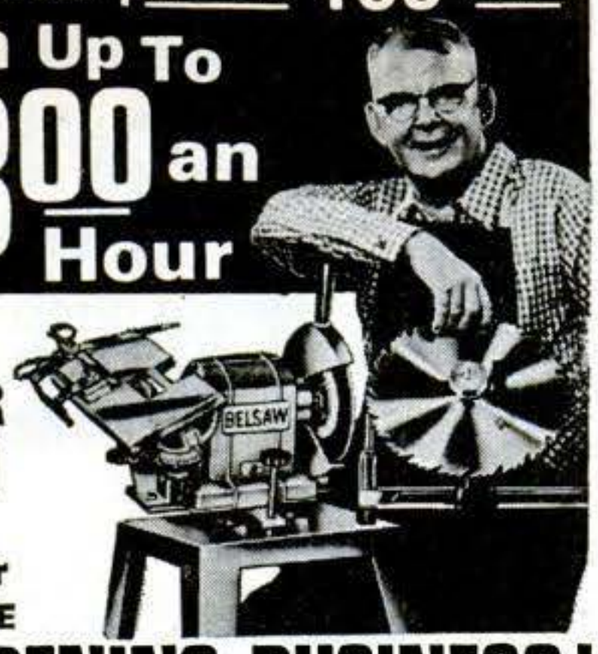

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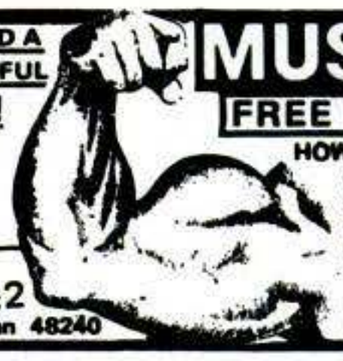

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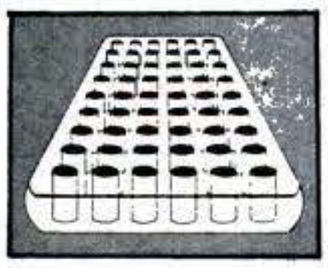

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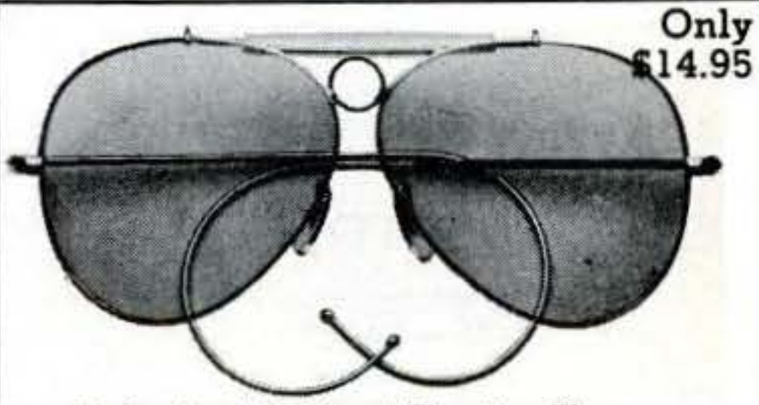

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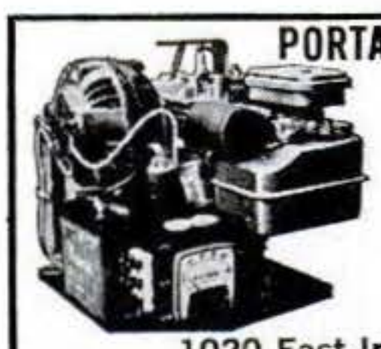

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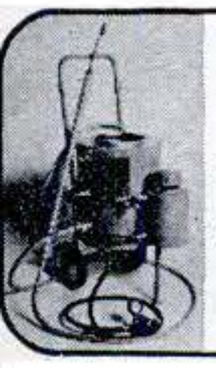

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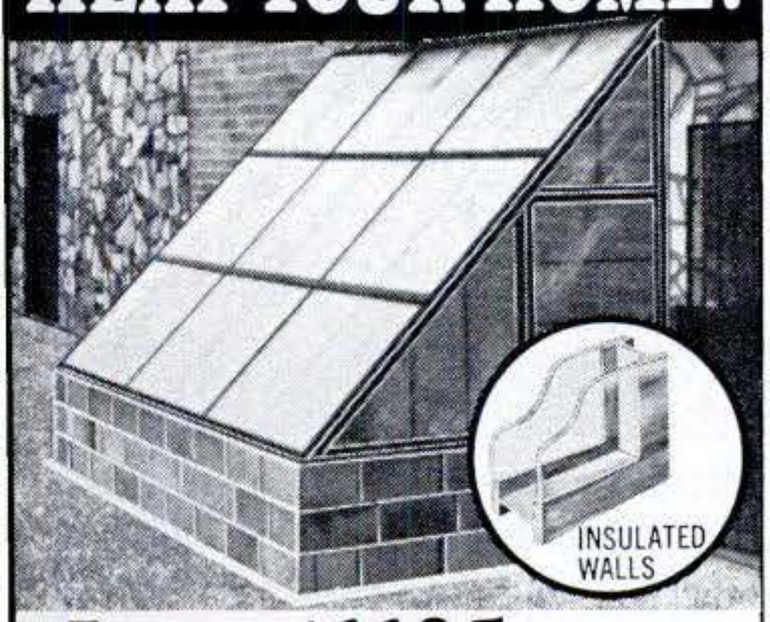

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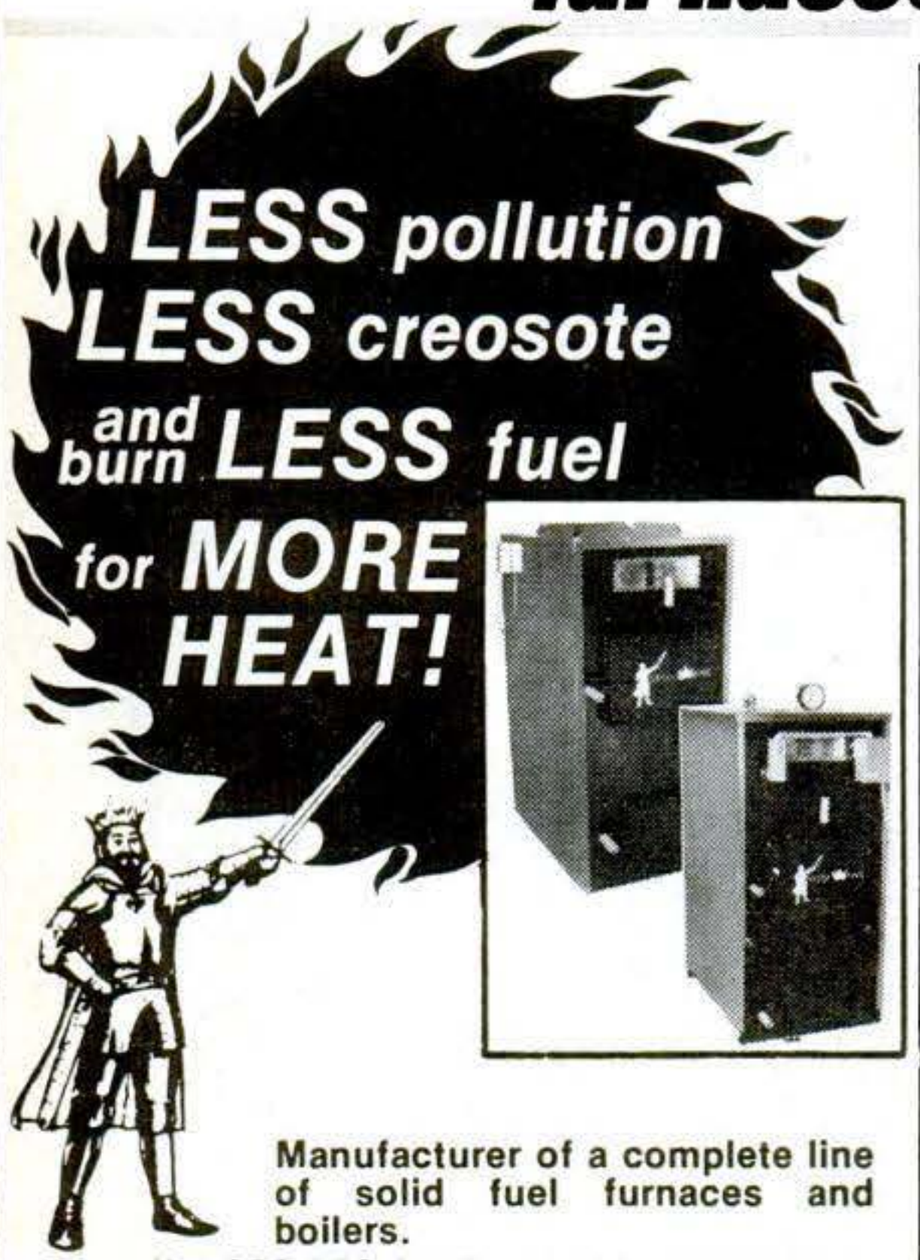

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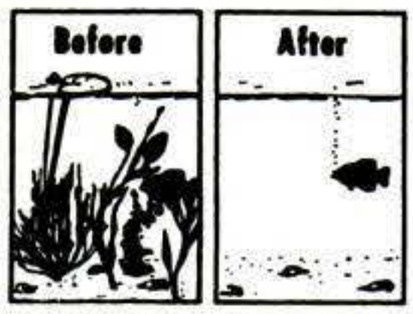

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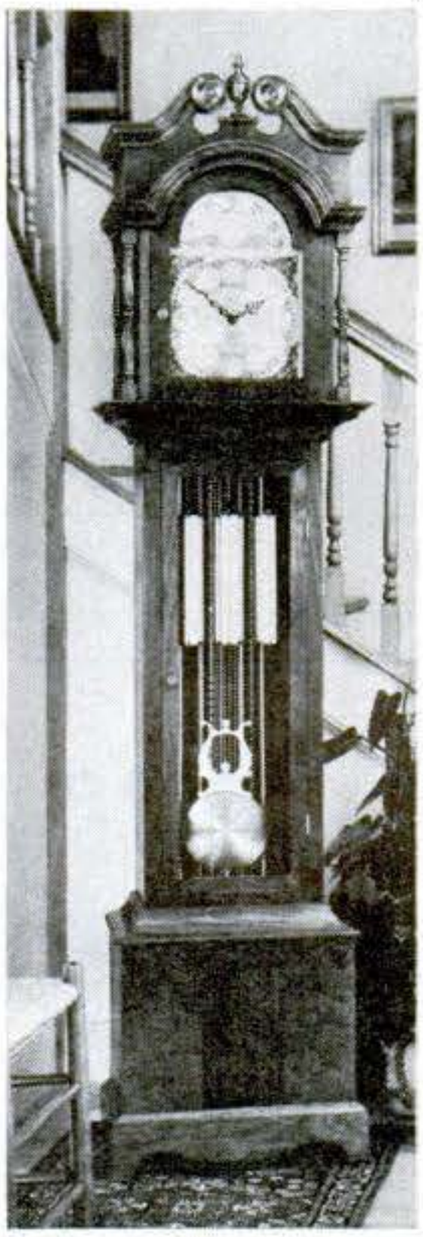

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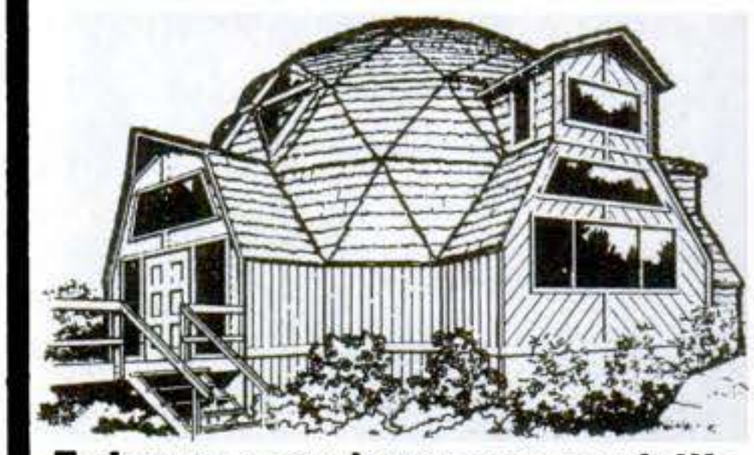

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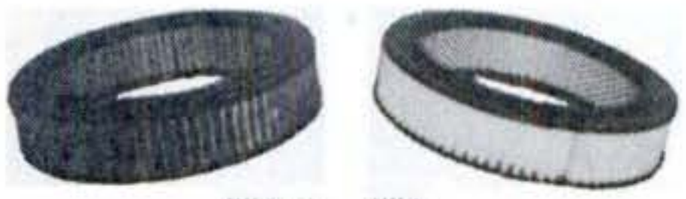

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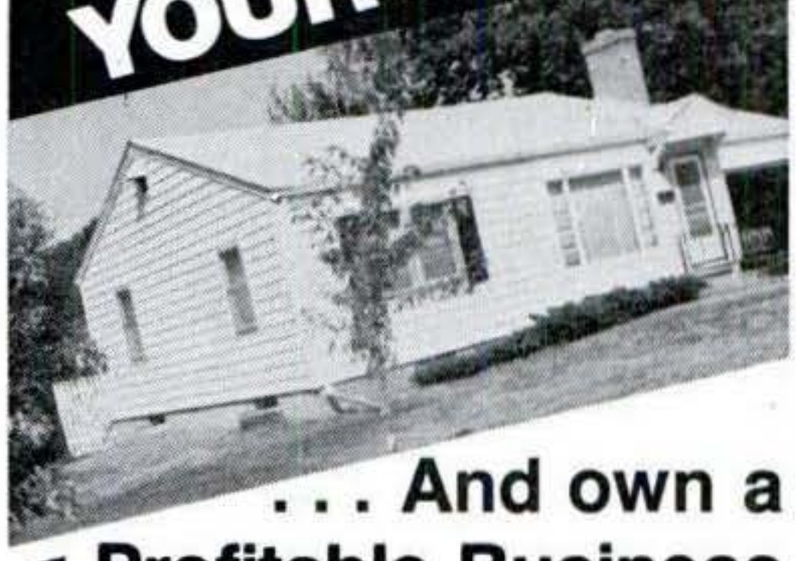

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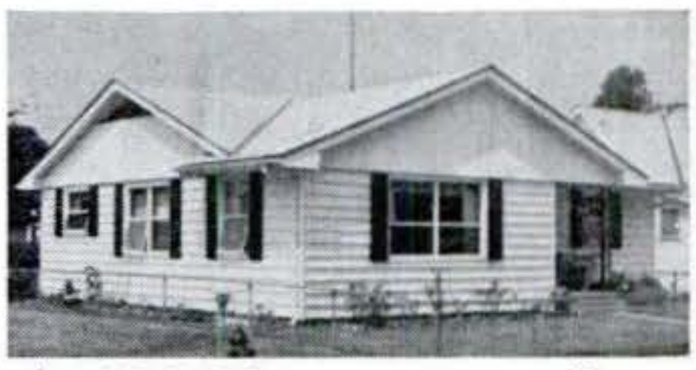

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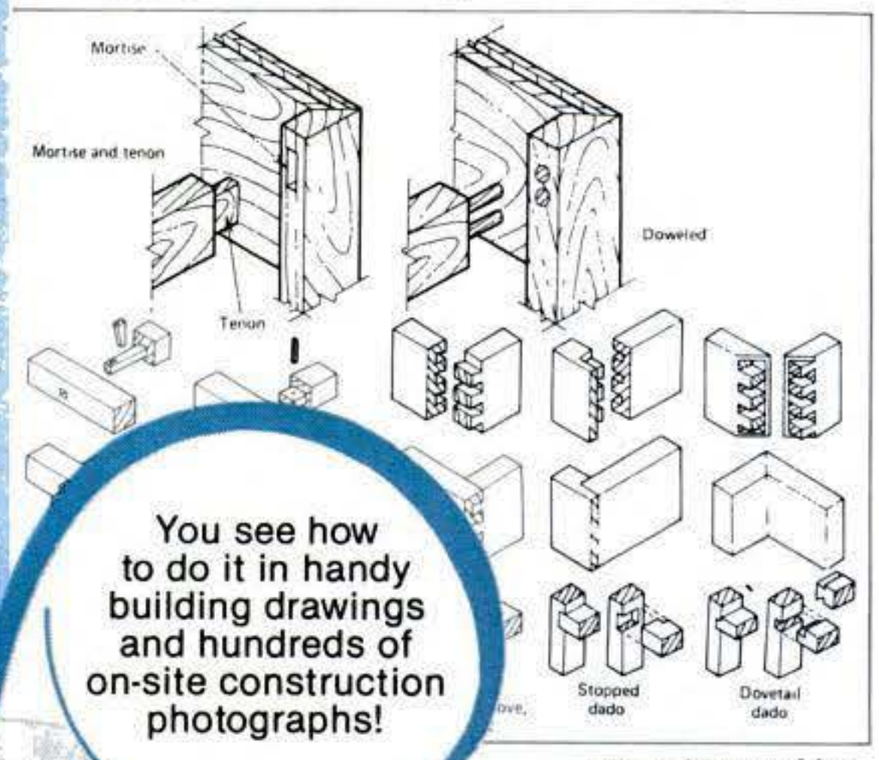

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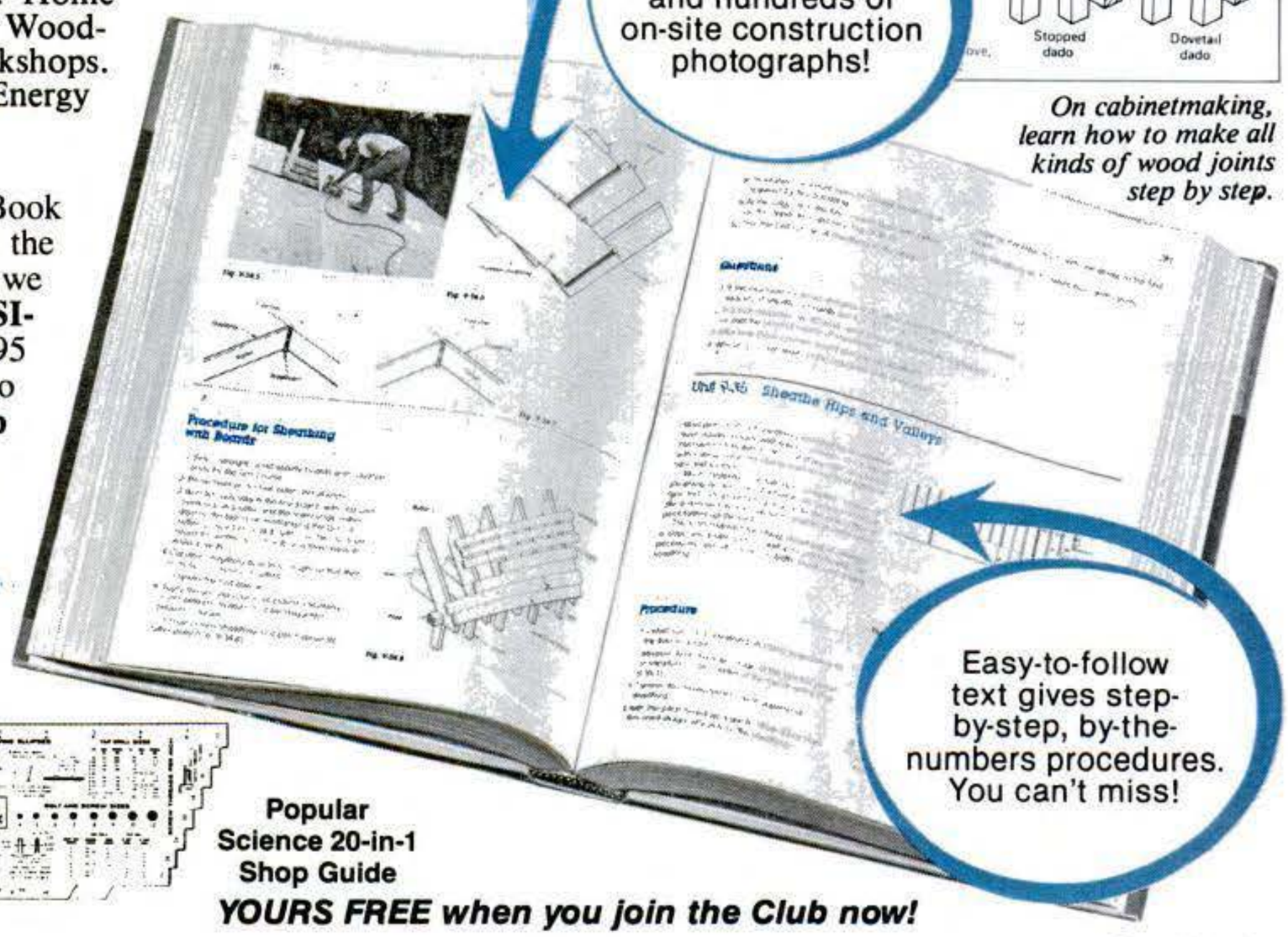

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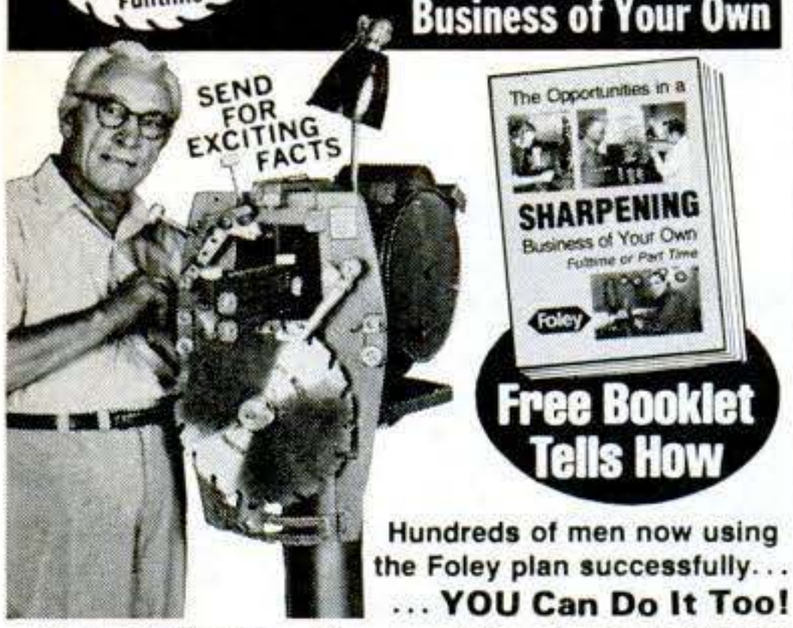

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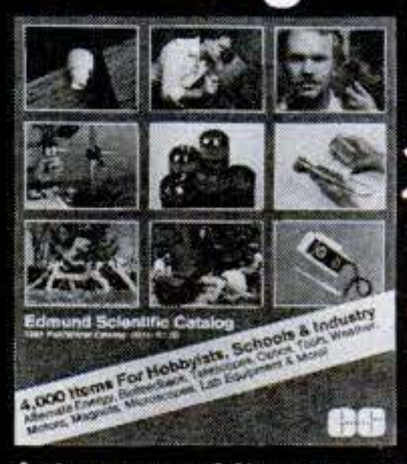

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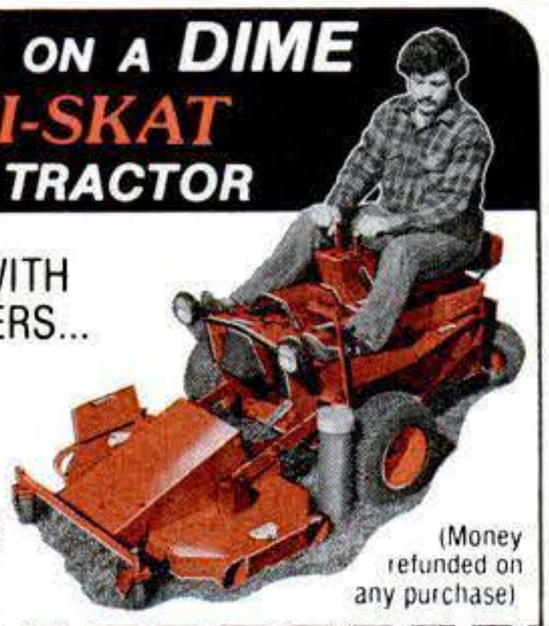

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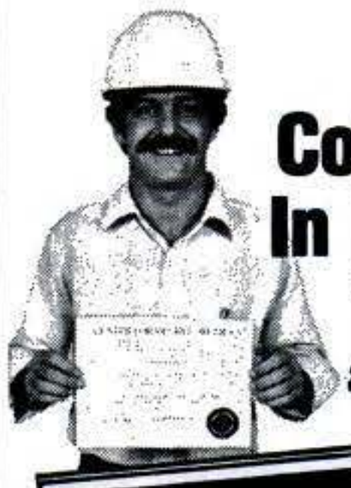

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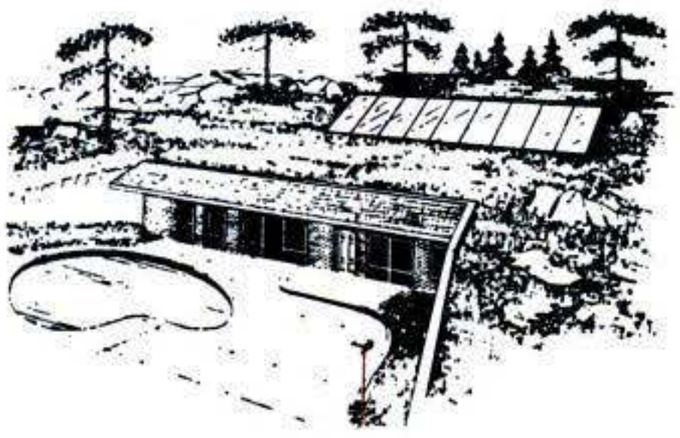

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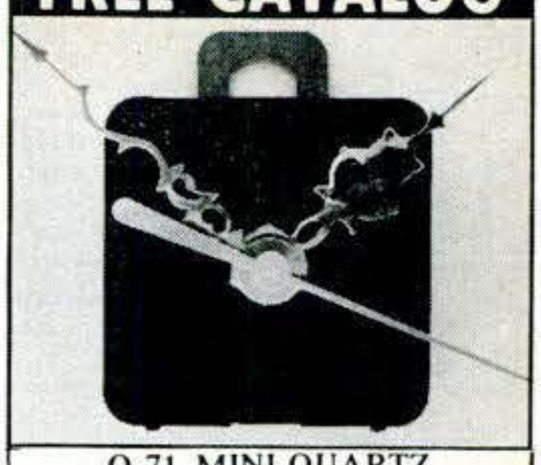

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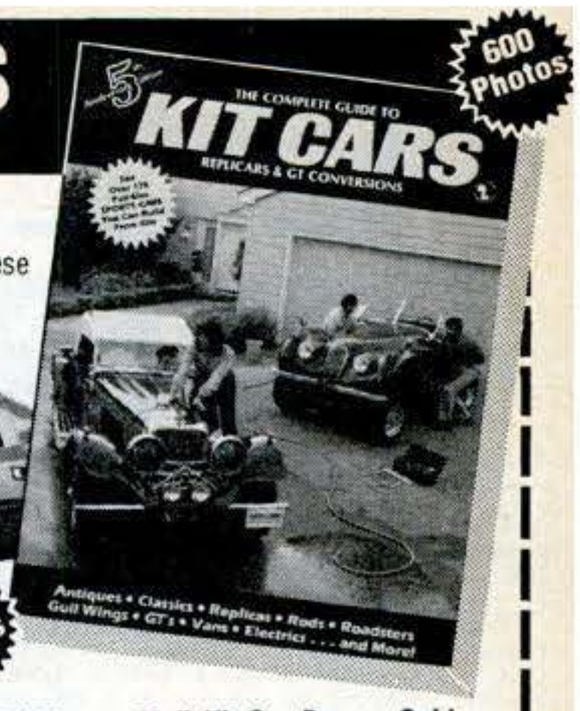

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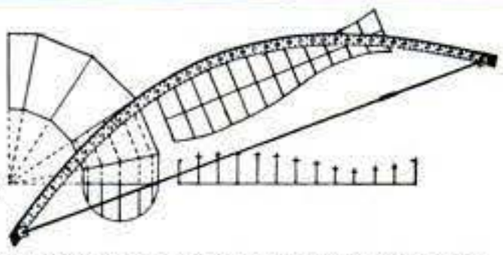

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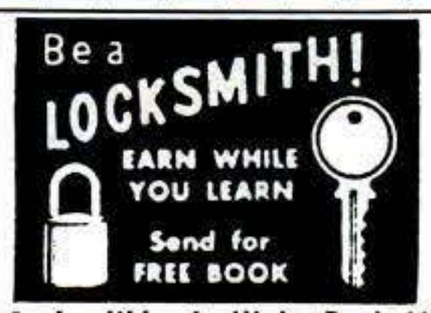

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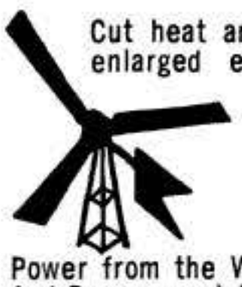

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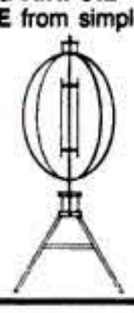

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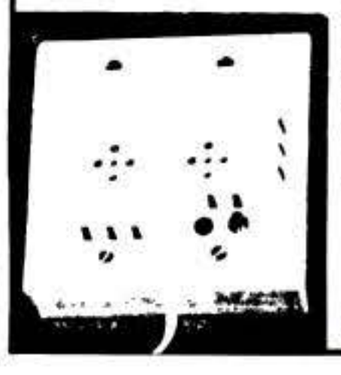

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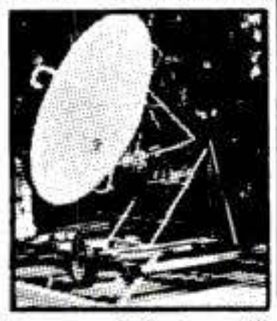

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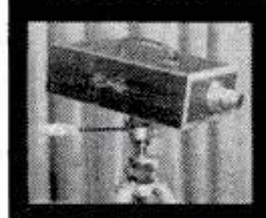

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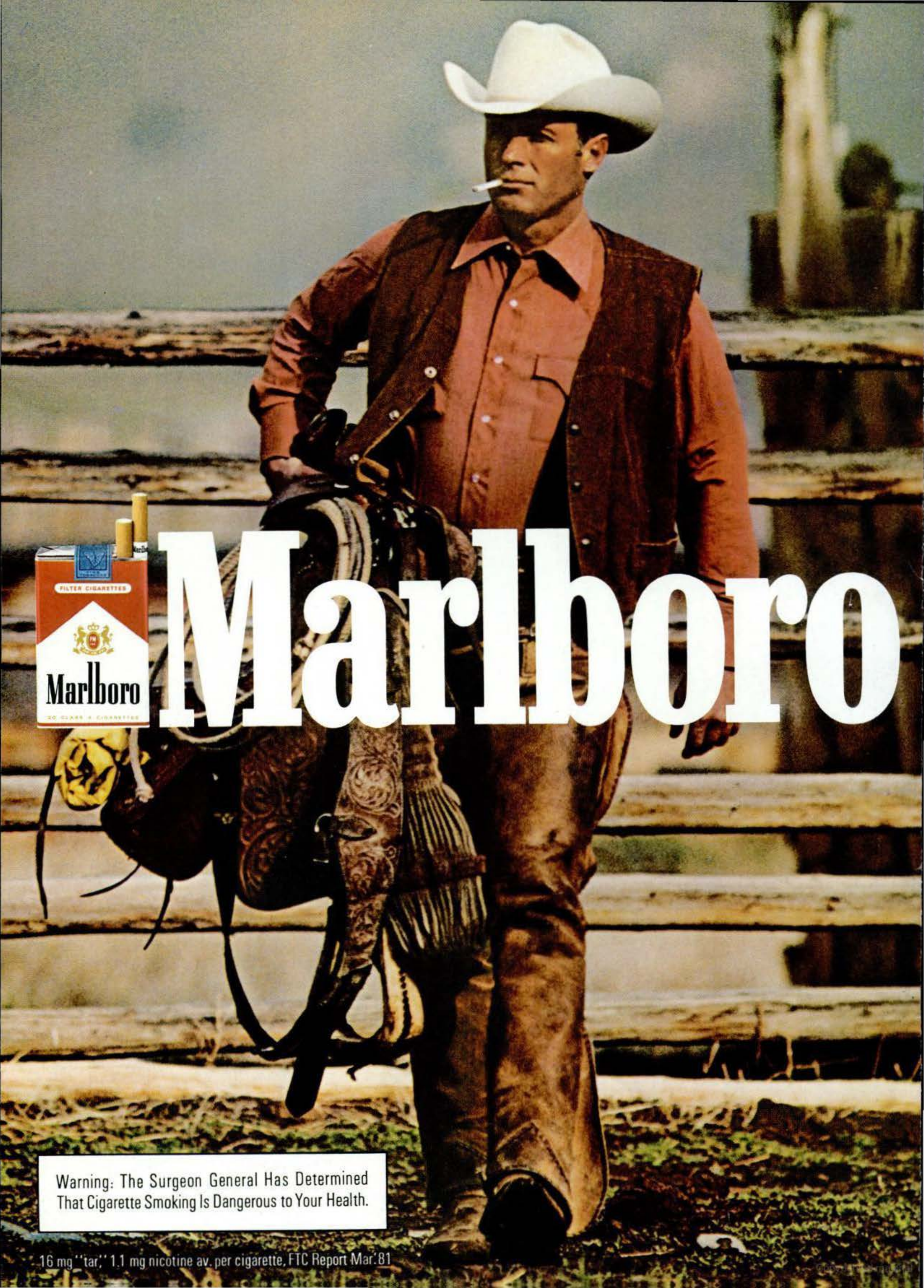
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